

# Global Soil Information Facilities - current status -

*Advancing the Science and Technology of Soil Information in Asia*



**World Soil Information**

H.I. Reuter

T. Hengl – G. Heuvelink –

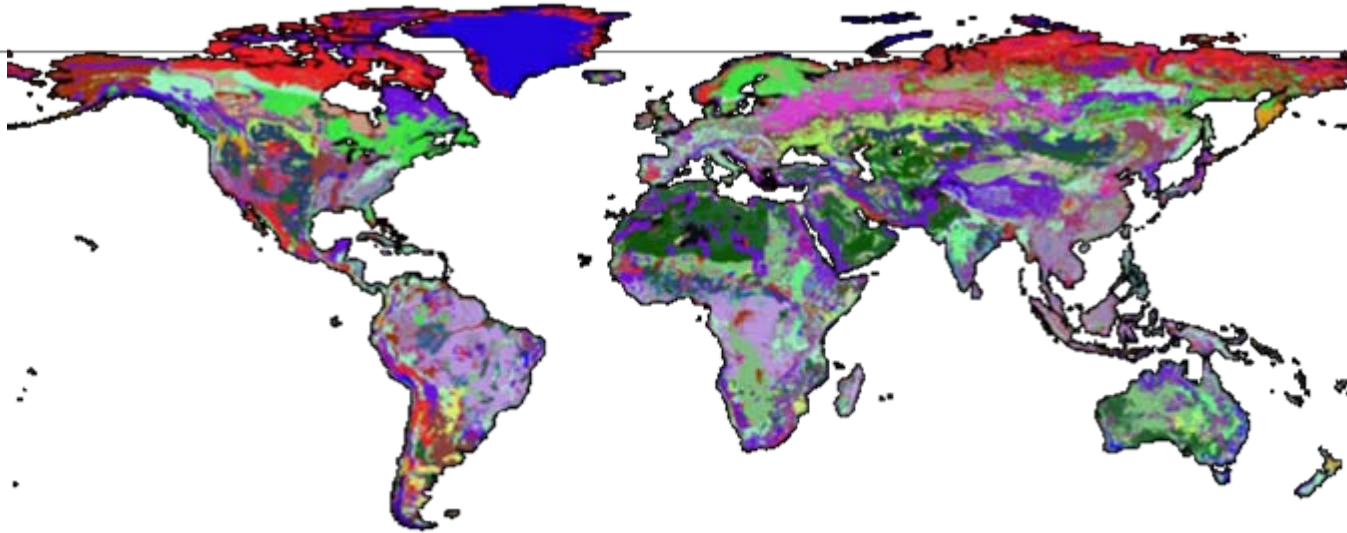
N. Batjes – J. Leenaars –

P. Tempel. - P. Bindraban- et al.

ISRIC

9.02.2012

# Harmonized World Soil Information



- The HWSD is a 30 arc-second raster database with over 16000 different soil mapping units that combines existing regional and national updates of soil information worldwide (SOTER, ESD, Soil Map of China, WISE) with the information contained within the 1:5 000 000 scale FAO-UNESCO Soil Map of the World (FAO, 1971/1981).



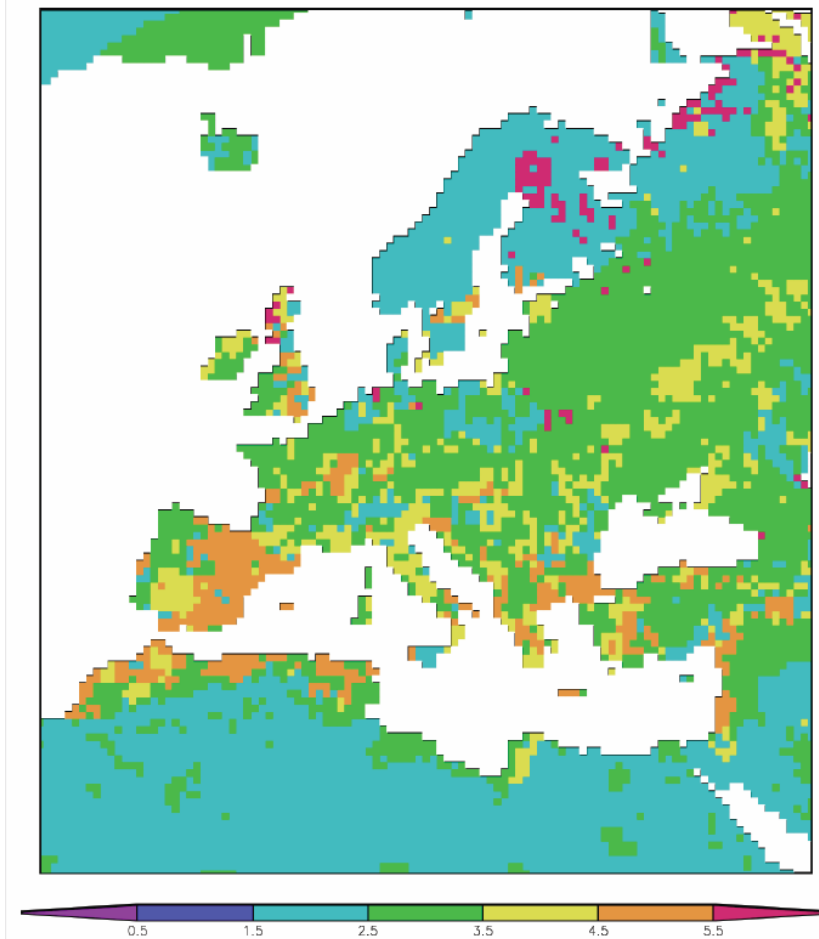
Rationale: (my personal interest)

## Soil in Climate Change - IPCC4(2007) / Ensemble RT3 climate runs (0.44d)

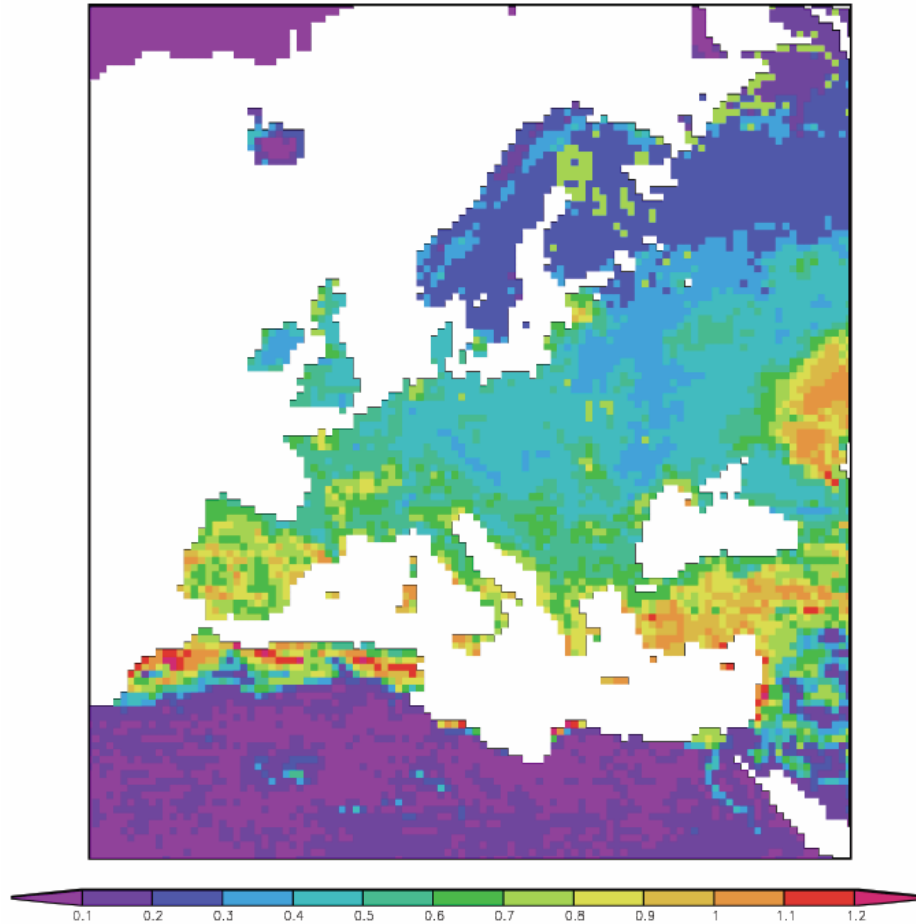
|     |   |       |   |  |          |
|-----|---|-------|---|--|----------|
| 225 | 1 | FAO   | g | comburent kinetic energy (C <sub>2</sub> ) | [ ]      |
| 226 | 1 | FAO   | g | FAO data set (soil data flags)             | [0...5.] |
| 227 | 1 | RGCGN | g | heat capacity of soil                      | [ ]      |
| 228 | 1 | SODIF | g | soil diffusivity                           | [ ]      |
| 229 | 1 | WSMX  | g | field capacity of soil                     | [m]      |



# FAO data set (soil fata flags)



# Field Capacity of soil [m]



# Background:

- Soil information is one of the key inputs to any global land use and/or environmental model (scenario testing);
- World (scientists, policy makers, crediting organizations, private sector, farmers) need soil information!
- Globally, soil information layer is one of the least detailed, consistent and complete layers:
- Too much focus on soil classes in the past
- Maps of key soil properties (organic carbon, NPK content, soil textures, water capacity, salinity/acidity) are often of poor accuracy and unknown Uncertainty;
- Users want not only raw soil info, but also the interpretation of soil data



# Objective:

---

- GSIF (Global Soil Information Facilities) is ISRIC's overarching framework for production of soil data.
- The main practical reason for GSIF is to build cyber-infrastructure to collate legacy (i.e., historic) soil data currently under threat of being lost forever.



# Key principles (I)

- Data collection in GSIF is based on crowd-sourcing - everyone collecting soil data or working with soil information is invited to contribute to some of the databases via data portals and to GSIF tools via GSIF software development portals. As such, GSIF follows the Wikipedia approach to building information systems.
- Data entered through GSIF data portals remain the property of the original contributors (copyright holders and/or authors). The original contributors have live access to their entries and full read/write rights.
- GSIF is mainly based on Free and Open Source Software (Linux, PHP, LaTeX, R, GDAL, GRASS, SAGA GIS, PostgreSQL, PostGIS, Python, Google Earth and similar), but other software packages may also be used.



# Key principles (II)

- GSIF has been designed to serve global soil mapping initiatives and not local, isolated (regional and national) projects. Internationally accepted standards (International System of Units, international soil classifications systems, FAO soil field description guides, World Geodetic System 1984, and similar) are recommended
- GSIF is based on automated procedures for mapping, pattern recognition and report/plots generation. All maps and reports produced as a part of GSIF are reproducible, i.e. they are based on compilable scripts that contain all processing steps. Derived maps can be updated by re-running the scripts with no or little human intervention when new data sets become available.
- All soil field records, output maps and tools used to generate maps will be made publicly available (Open Access) in near real-time.



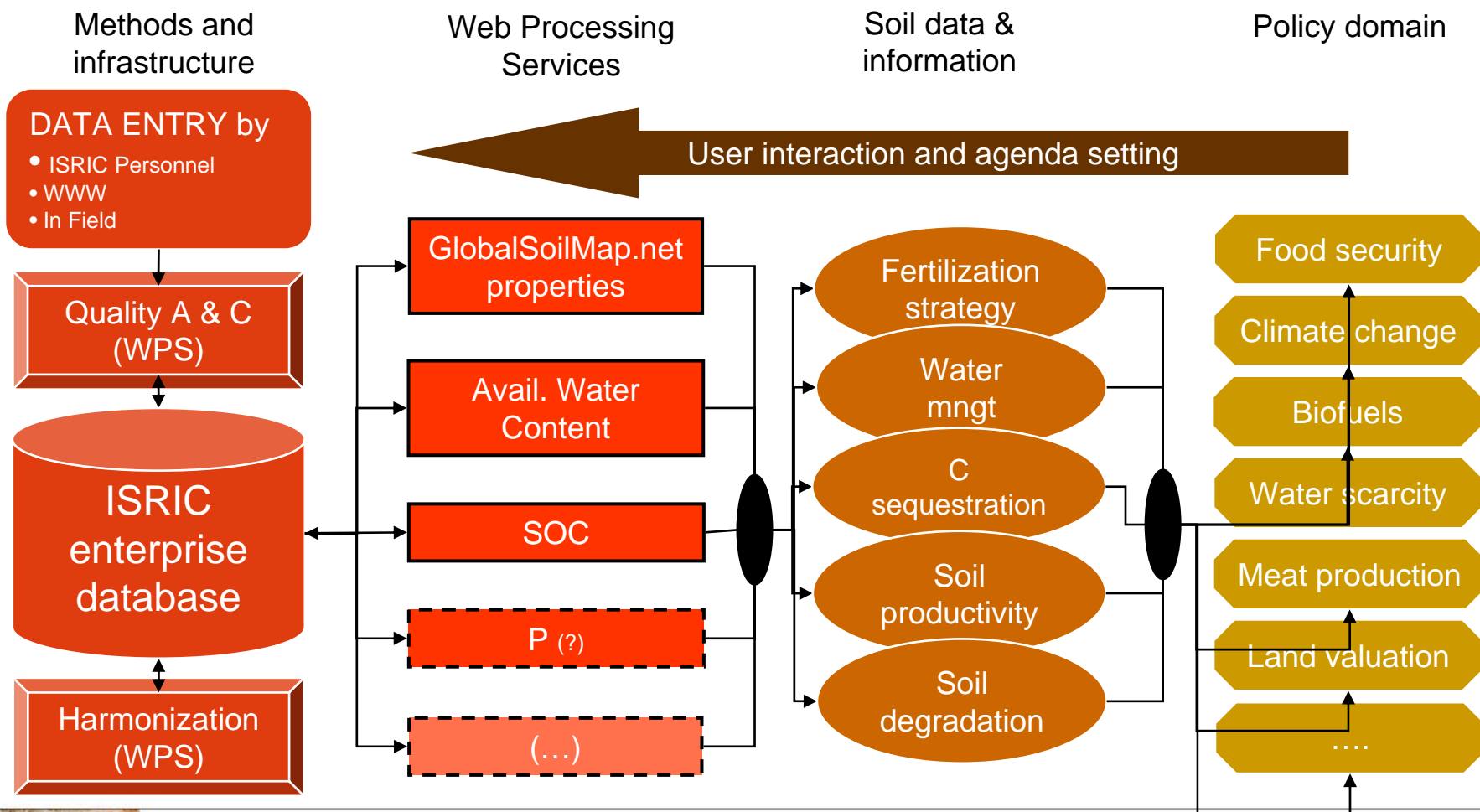
# Key principles (III)

---

- GSIF is a framework for global collaborative cooperation.
- GSIF is a framework for global soil map generation at various scales.
- GSIF **requires** soil knowledge from local participants.



# Linking ISRIC soil information to policy



# Global Soil Information Facilities (GSIF)



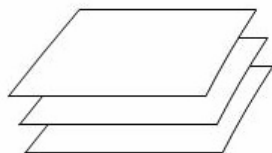
**World Soil Information**

### Open Soil Profiles

- Soil variables
- Soil site info
- Soil analytical data
- Descriptive properties

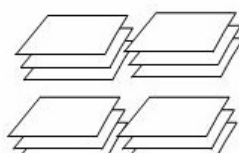
### Soil covariates (worldgrids)

Global



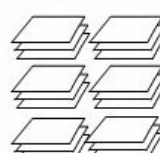
5.6 km repository

Continental scale



1 km repository

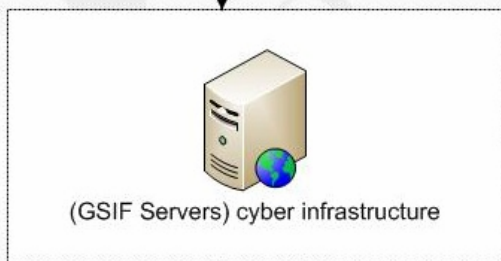
Country/state-level



100 / 250 m repository

### Area-class maps

- Scale:  
Global, Continental, regional
- Soil property:  
Taxonomical / analytical / site data



### GSIF Packages

- [Map import module](#)
- [Data entry module](#)
- [Harmonization module](#)
- [Spline fitting](#)
- [Spatial analysis module](#)
- [plotKML](#)
- [Data conversion to R](#)
- [Data visualization](#)
- [Data export](#)

### Webmapping API

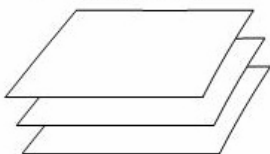
- [Real-time spatial prediction \(Google Maps\)](#)
- [GlobalSoilMap.net functionality for web-applications](#)
- [Geo-serving and geoprocessing functionality](#)

GlobalSoilMap.net



### Derived soil property maps

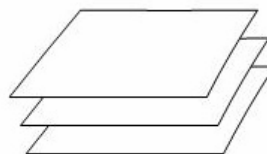
Global coverage



100 m (250 m, 1 km and 5.6 km)

- Six+four key soil parameters (organic carbon, pH, clay, silt, sand, coarse fragments)
- at six standard depths (0-5, 5-15, 15-30, 30-60, 60-100, 100-200 cm)
- and with included upper and lower 95% probability ranges

### Derived area-class maps



1 : 5M, 1 : 1M, 1 : 0.5M, 1 : 0.25M

- Qualitative + quantitative soil properties
- Defined depth ranges (FAO: 0-30 and 30-100; SOTWIS: 0-20, 20-40, 40-60, 60-80, 80-100)
- Documented uncertainties



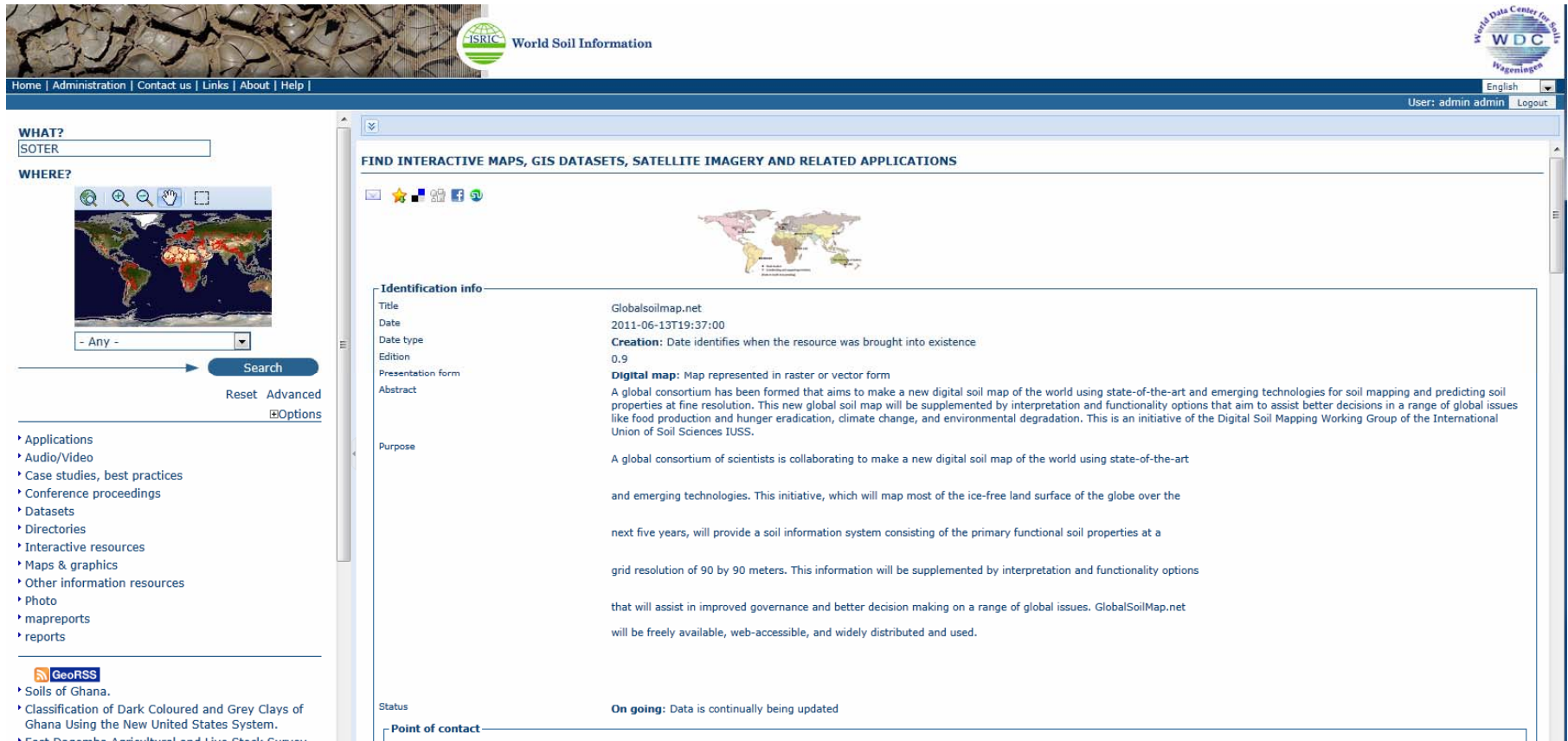
World Soil Information

www.isric.org

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# ISRIC – Data Discovery

What kind of data holds ISRIC ? e.g. Scanned Maps, GIS datasets & Reports



The screenshot displays the ISRIC World Soil Information website interface. At the top, there is a navigation bar with links for Home, Administration, Contact us, Links, About, and Help. The user is logged in as 'admin admin' and the language is set to English. The main content area is titled 'FIND INTERACTIVE MAPS, GIS DATASETS, SATELLITE IMAGERY AND RELATED APPLICATIONS'. On the left, there is a search interface with a 'WHAT?' field containing 'SOTER' and a 'WHERE?' field with a world map. Below the search fields are buttons for 'Search', 'Reset', and 'Advanced Options'. A list of categories is visible on the left, including Applications, Audio/Video, Case studies, best practices, Conference proceedings, Datasets, Directories, Interactive resources, Maps & graphics, Other information resources, Photo, mapreports, and reports. The main content area displays a metadata record for 'Globalsoilmap.net'. The record includes the following information:

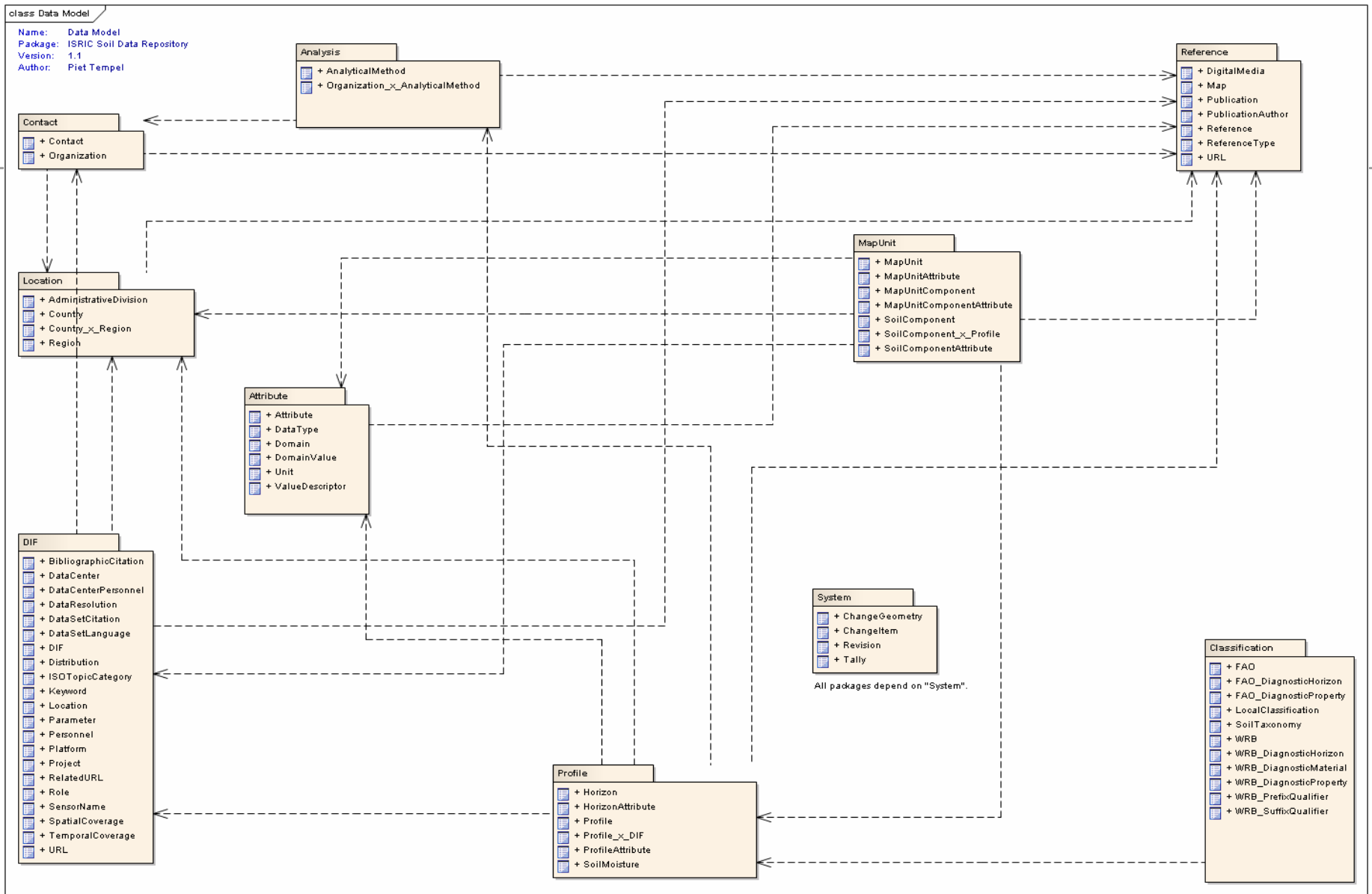
| Identification info |   |
|---------------------|---|
| Title               | Globalsoilmap.net   |
| Date                | 2011-06-13T19:37:00   |
| Date type           | <b>Creation:</b> Date identifies when the resource was brought into existence   |
| Edition             | 0.9   |
| Presentation form   | <b>Digital map:</b> Map represented in raster or vector form  |
| Abstract            | A global consortium has been formed that aims to make a new digital soil map of the world using state-of-the-art and emerging technologies for soil mapping and predicting soil properties at fine resolution. This new global soil map will be supplemented by interpretation and functionality options that aim to assist better decisions in a range of global issues like food production and hunger eradication, climate change, and environmental degradation. This is an initiative of the Digital Soil Mapping Working Group of the International Union of Soil Sciences IUSS.  |
| Purpose             | A global consortium of scientists is collaborating to make a new digital soil map of the world using state-of-the-art and emerging technologies. This initiative, which will map most of the ice-free land surface of the globe over the next five years, will provide a soil information system consisting of the primary functional soil properties at a grid resolution of 90 by 90 meters. This information will be supplemented by interpretation and functionality options that will assist in improved governance and better decision making on a range of global issues. GlobalSoilMap.net will be freely available, web-accessible, and widely distributed and used. |
| Status              | <b>On going:</b> Data is continually being updated  |
| Point of contact    |   |



OGC conforming MetaDataService  
World Soil Information

<http://meta.isric.org>

Advancing the Science and Technology of Soil Information in Asia

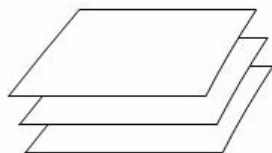


### Open Soil Profiles

- Soil variables
- Soil site info
- Soil analytical data
- Descriptive properties

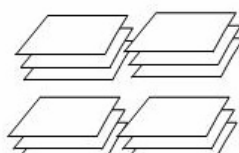
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Global



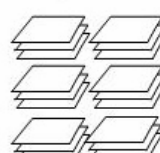
5.6 km repository

Continental scale



1 km repository

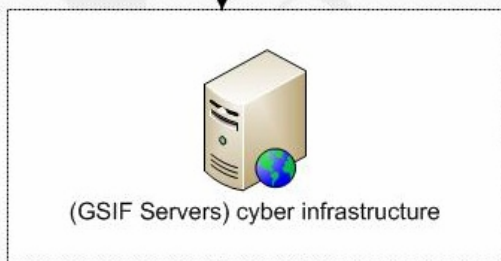
Country/state-level



100 / 250 m repository

### Area-class maps

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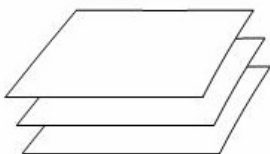
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GlobalSoilMap.net



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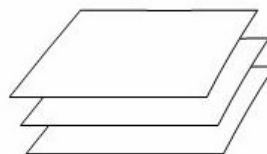
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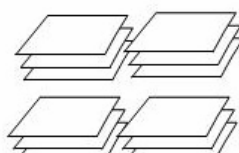
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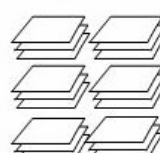
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Continental scale



1 km repository

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100 / 250 m repository

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(GSIF Servers) cyber infrastructure

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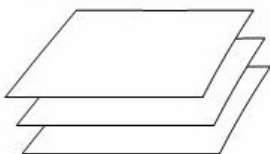
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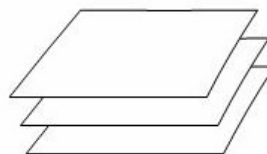
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World Soil Information

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# OpenSoilProfile data portal



**World Soil Information**

# Why do we need OpenSoilProfile?

---

- Objective:

OpenSoilProfile is a (de)-central repository for collecting, storing, accessing and interacting with soil profile observations

- Rationale:

OpenSoilProfile is a part of a larger GSIF. It is the physical implementation of ISRIC's contribution to fulfil its mandate as World data centre for soil to "Serve the scientific community as custodian of global soil information"





## Open Soil Profiles

Open Soil Profiles is an unified soil profile database of the World. **This website is under construction. To test the functionality, please consider [registering](#).**



[\[advanced search\]](#)

Enter a soil variable and a country name, example: "soil pH ", "Brazil". To list all profiles in a country simply select country and press "search by country".

### Browse fields

- [Contributing organizations](#)
- [Why contribute?](#)
- [Recent uploads](#)
- [Literature sources](#)
- [Most downloaded](#)

### Information

- [About Open Soil Profiles](#)
- [Minimum requirements](#)
- [Registered users](#)
- [Contact us](#)
- [Join the mailing list](#)
- [Donations and Sponsoring](#)
- [Other data products by ISRIC](#)

### Upload profile data

- [How to prepare data for OSP?](#)
- [Column naming conventions](#)
- [Software tools](#)

### Download data

- [Browse data](#)
- [Disclaimer and the default license](#)
- [How to link to MySQL db?](#)



World Soil Information

<http://soilprofile.org/>

Advancing the Science and Technology of Soil Information in Asia

# Search Screen



Search Results Summary

Location   
Latitude   
Longitude   
Entry template

Within specified radius of marker   
Radius   
Unit

Search within current viewport

Powered by Geonames  
Enter a place name in the search box

# Search Screen – via GeoNames and Extent

Entry template

Within specified radius of marker

Radius

Radius

Unit

Search within current viewport

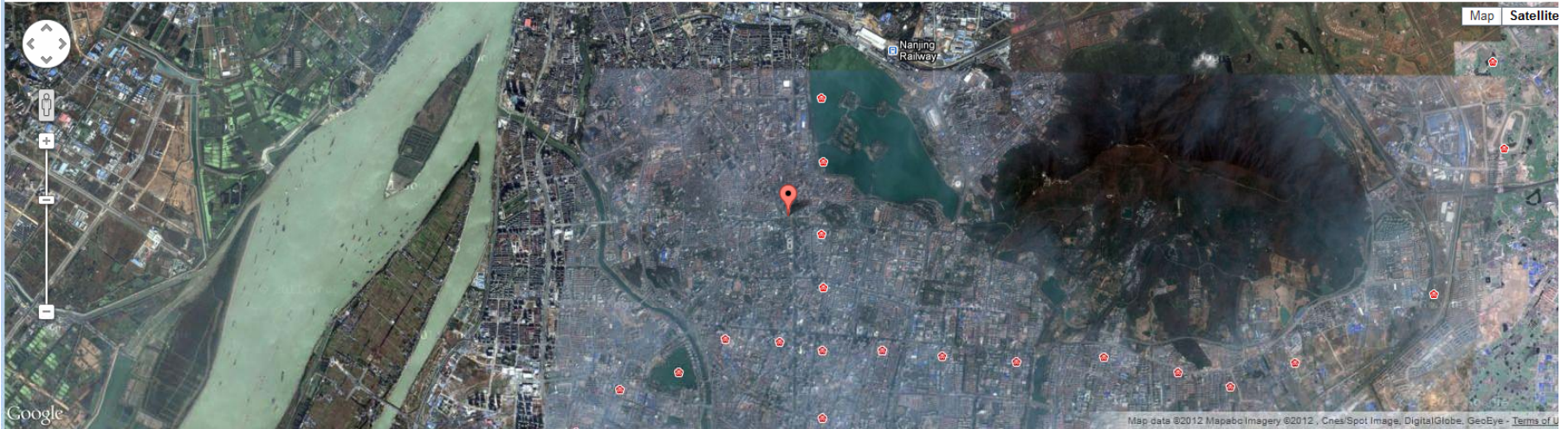
Powered by [Geonames](#)

| Name                    | Feature type                                  | Country | Administrative unit |
|-------------------------|---|---------|---------------------|
| <a href="#">Nanjing</a> | seat of a first-order administrative division | China   | Jiangsu Sheng       |
| <a href="#">Nanjing</a> | second-order administrative division          | China   | Jiangsu Sheng       |
| <a href="#">Nanjing</a> | airport                                       | China   |                     |
| <a href="#">Nanjing</a> | populated place                               | Taiwan  | Taiwan              |
| <a href="#">Nanjing</a> | populated place                               | China   | Guangdong Sheng     |



World Soil Information

## Search profiles



Search

Results

Summary

Location Nanjing (seat of a first-order administrative division) ,Jiangsu Sheng, China

Latitude

Longitude

Entry template

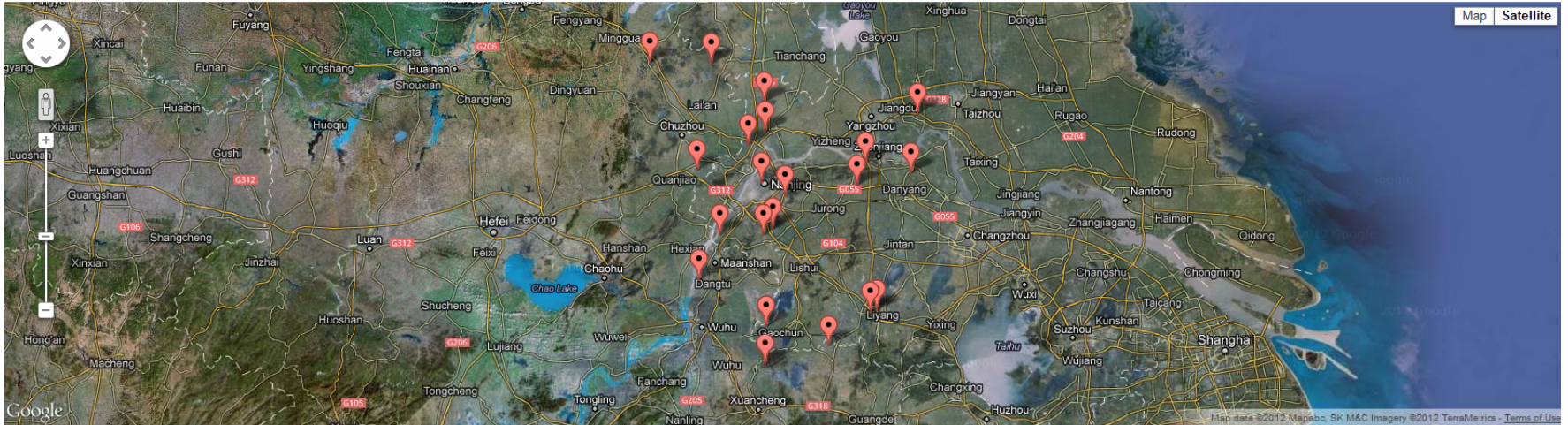


World Soil Information

Advancing the Science and Technology of Soil Information in Asia

# Results (100km)

## Search profiles

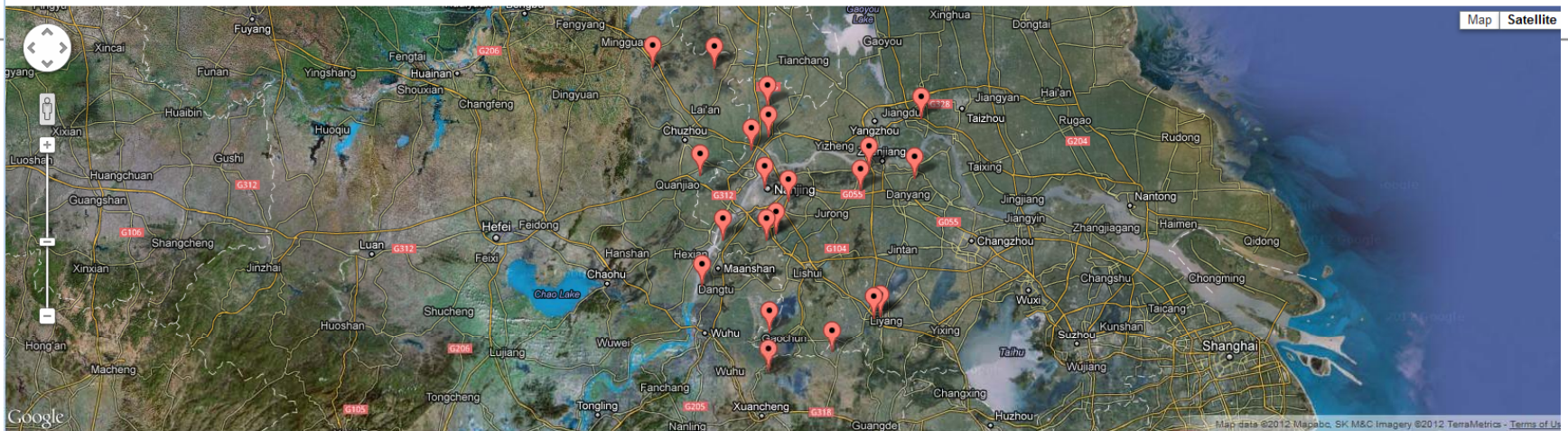


| Search | Results | Summary              |
|--------|---------|----------------------|
|        | ▶       | China, mainland 1354 |
|        | ▶       | China, mainland 1394 |
|        | ▶       | China, mainland 1395 |
|        | ▶       | China, mainland 1400 |
|        | ▶       | China, mainland 1417 |



# Results (100km) – One Example

Search profiles



Search Results Summary

China, mainland 1354

Distance to centroid 99.8 kilometers

Drainage class Moderately well drained

Elevation 80 (meter)








World Soil Information

# Template Selection and Editing

(like your online banking)

## Entry Templates for guest

| Available entry profiles |   |   |
|--------------------------|---|---|
|                          | Entry profile  | Description   |
| 1                        | <a href="#">Guidelines for soil description - FAO 1990</a>                                      | Guidelines for soil description - Third (revised) edition. FAO, Rome 1990               |
| 2                        | <a href="#">Guidelines for soil description - FAO 2006</a>                                      | Guidelines for soil description - Fourth edition. FAO, Rome 2006                        |
| 3                        | <a href="#">Hannes2JRC</a>  | Example to be shown   |
| 4                        | <a href="#">myData</a>  | Based in WISE3 data protocol.   |
| 5                        | <a href="#">myData2</a>   | Another myData, without a template.   |
| 6                        | <a href="#">PT_testing tabs</a>   |   |
| 7                        | <a href="#">SOTER 1995 Adapted</a>  | SOTER 1995 - Expanded with a number of fields.  |
| 8                        | <a href="#">SOTER Procedures Manual - 1995</a>  | Global and National Soils and Terrain Digital Database (SOTER) Procedures Manual. ISRIC |
| 9                        | <a href="#">TEST_5</a>  | TEST_5 description. VERANDERD.EN NOG EEN KEER   |
| 10                       | <a href="#">TEST_6</a>  | Hannes very STUPID request  |

+    Page 1 of 2 10 



# Template Selection and Editing –

select YOUR properties/methods and where to show them

## Entry Profile

Available fields for this entry profile

### Available properties for this profile

|    | Attribute ↕  | Terrain property | Site property | Horizon property | Analytical method | Tab   |
|----|--|------------------|---------------|------------------|-------------------|-------|
| 1  | Base saturation (as percentage of CEC)             | False            | False         | False            | Unknown           | Tab 1 |
| 2  | Cation Exchange capacity (CEC)                     | False            | False         | False            | Unknown           | Tab 1 |
| 3  | Clay content (generic)                             | False            | False         | False            | Unknown           | Tab 1 |
| 4  | Climate (domain: Value domain for climate (defined | False            | False         | False            | Unknown           | Tab 1 |
| 5  | Coarse fragments content                           | False            | False         | False            | Unknown           | Tab 1 |
| 6  | Depth of soil                                      | False            | False         | False            | Unknown           | Tab 1 |
| 7  | Edition (year) of USDA Soil Taxonomy               | False            | False         | False            | Unknown           | Tab 1 |
| 8  | Electrical conductivity (generic)                  | False            | False         | False            | Unknown           | Tab 1 |
| 9  | Exchangeable Acidity (H+ and Al+++)                | False            | False         | False            | Unknown           | Tab 1 |
| 10 | Horizon designation                                | False            | False         | True             | Unknown           | Tab 1 |



# Add/ Edit Function

Add / Edit/ Delete/ Reload / Map / Inline Editing




## Select an Entry template

The selected entry template will be used in the profile grid - showing only the site columns that are part of the entry template.  
To edit or add an entry template, [go here](#).

Select an entry template

To change the order of the columns in your current entry template, [go here](#).

## Add/edit a profile

| AVAILABLE profiles for guest  |            |            |          |           |           |            |                              |                |
|---|------------|------------|----------|-----------|-----------|------------|------------------------------|----------------|
|   | Profile ID | Country ↕  | Latitude | Longitude | Synthetic | Dataset(s) | Soil profile description sta | Sampling month |
| 1   |            |            |          |           |           |            |                              |                |
| 2   |            |            |          |           |           |            |                              |                |
| 3   |            |            |          |           |           |            |                              |                |
| 4   |            |            |          |           |           |            |                              |                |
| 5   |            |            |          |           |           |            |                              |                |
| 6   |            |            |          |           |           |            |                              |                |
| 7   |            |            |          |           |           |            |                              |                |
| 8   |            |            |          |           |           |            |                              |                |
| 9   |            |            |          |           |           |            |                              |                |
| 10  | 13648      | Luxembourg | 50.5     | 6.015     | False     | ±/ None    |                              |                |
| +    Map |            |            |          |           |           |            |                              |                |



# Edit additional properties

## Additional data group

Some text

|   | Profile ID | Top (cm) | Bottom (cm) | Clay (weight%) | Total sand (weight%) | Silt (weight%) | Total nitrogen (g/kg) | Organic |
|---|------------|----------|-------------|----------------|----------------------|----------------|-----------------------|---------|
| 1 | 13653      | 0        | 10          |                |                      |                | 10.78                 | 12.55   |

+ ✎ 🗑️ ↻

Page 1 of 1 5 ▾

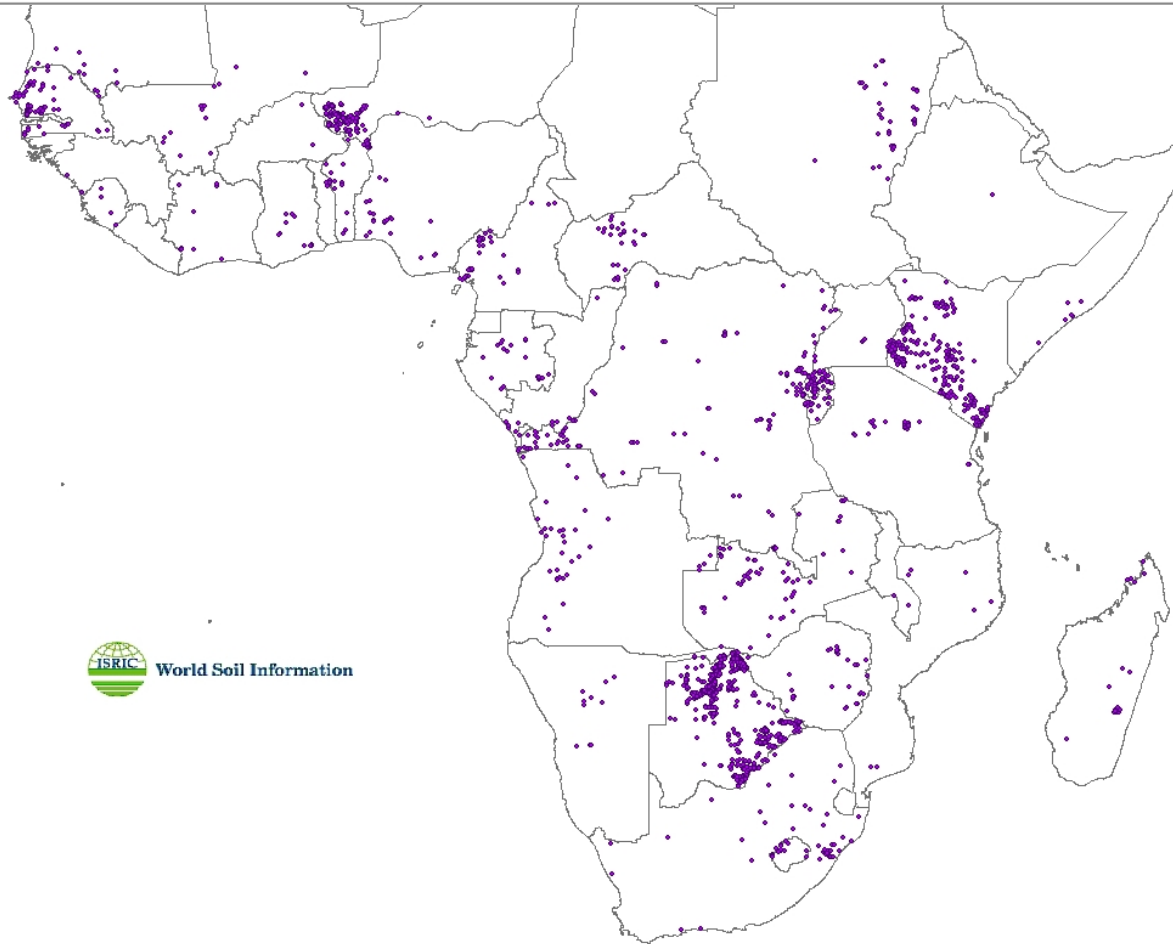
## Data group 1

Some text

|   | Profile ID | Top (cm) | Bottom (cm) | Gypsum (g/kg) | Horizon designation | Electrical conductivity (gei) | pH (H2O) |     |
|---|------------|----------|-------------|---------------|---------------------|-------------------------------|----------|-----|
| 1 | 13653      | 0        | 10          |               |                     |                               | 5.6      | 5.7 |
| 2 | 13653      | 10       | 18          |               |                     |                               | 7.8      | 7.5 |
| 3 | 13653      | 18       | 24          |               |                     |                               | 7.6      |     |



# 2010 AfSP baseline : **2770** profiles



Wise



World Soil Information



Africa Soil Information Service  
AfricaSoils.net



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# 2010 AfSP incl. ISRIC sets : **4343** profiles

Wasp

Soter1

Soter2

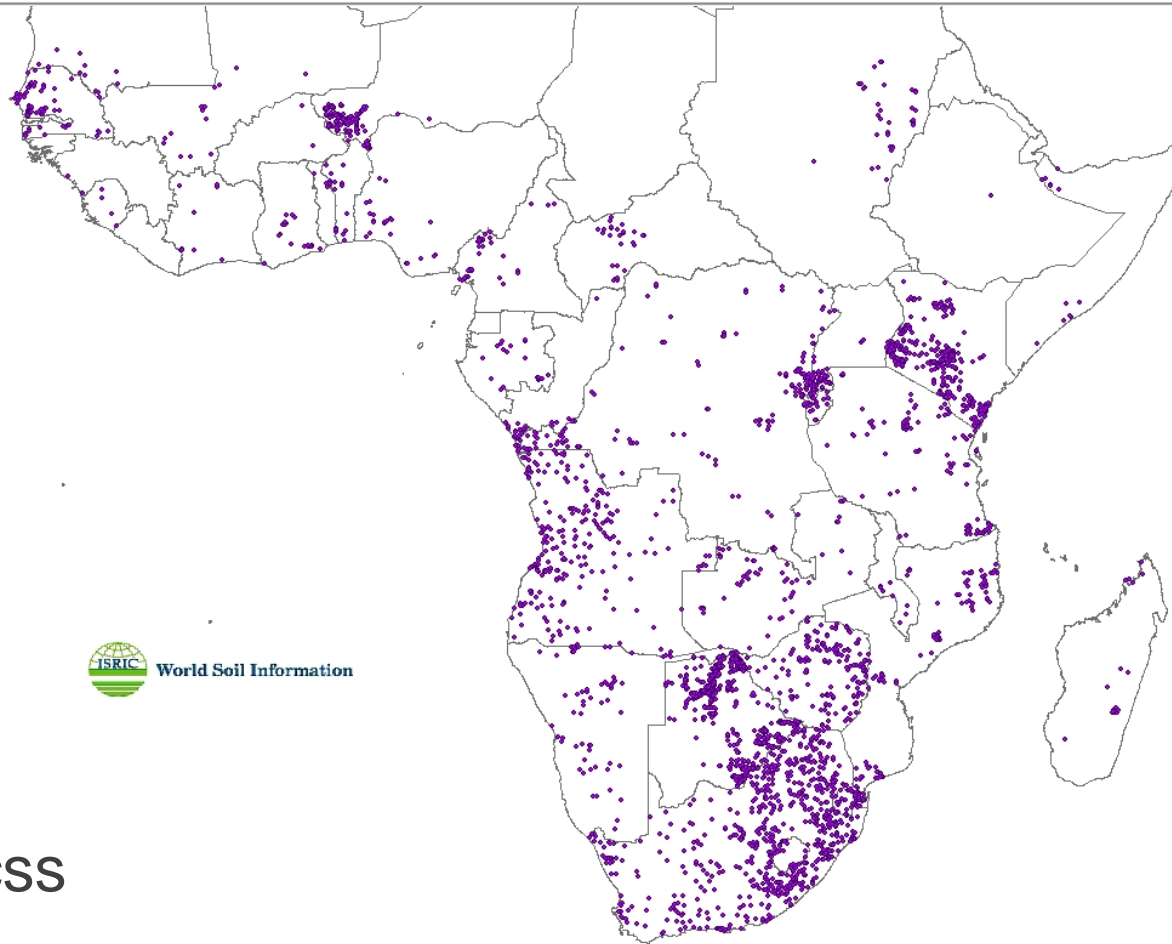
Soter3

Soter4

Soter5

Wise

Isis & Ncss



World Soil Information



Africa Soil Information Service  
AfricaSoils.net



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# 2010 AfSP incl. ISRIC sets : **4343** profiles

Wasp

Soter1

Soter2

Soter3

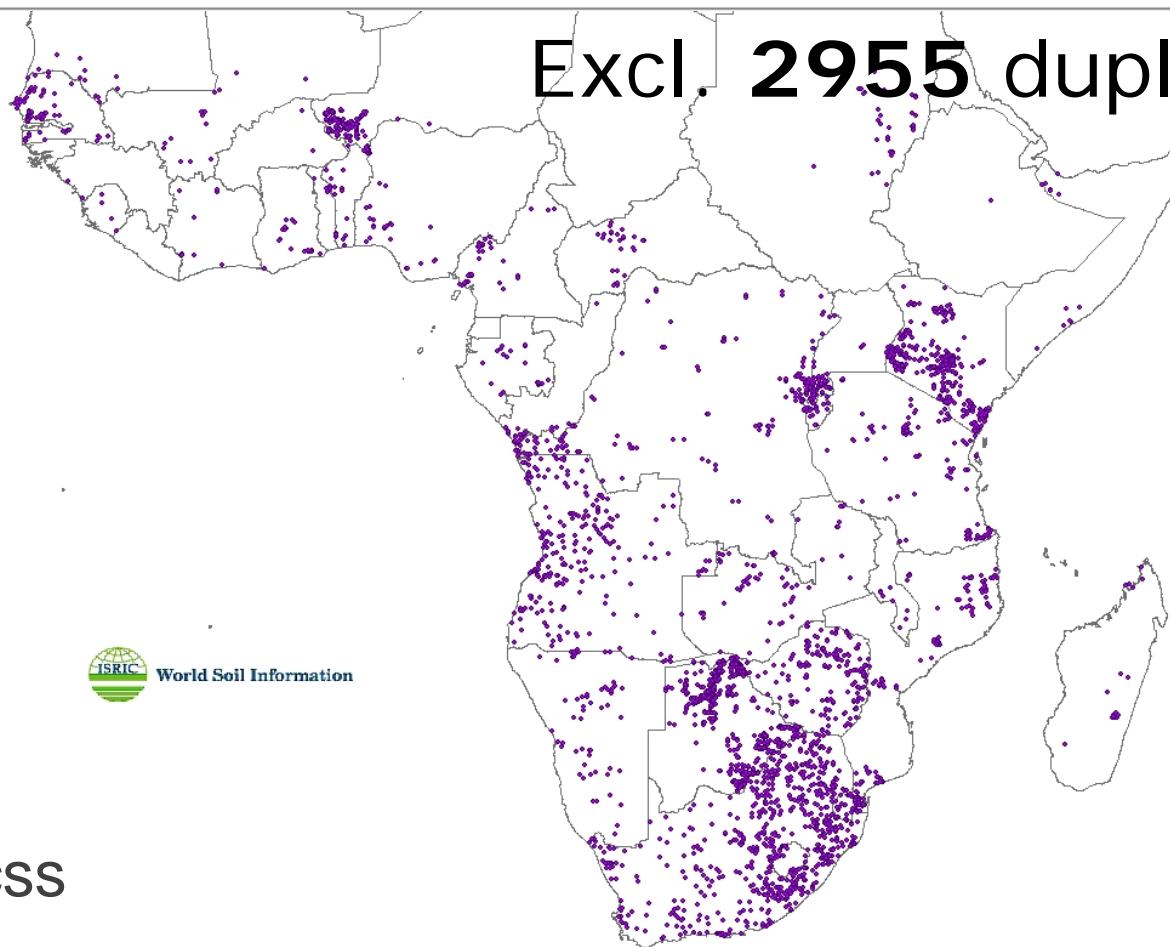
Soter4

Soter5

Wise

Isis & Ncss

Excl. **2955** duplicates



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# 2010 AfSP 1<sup>st</sup> version : **7300** profiles

Tanzania

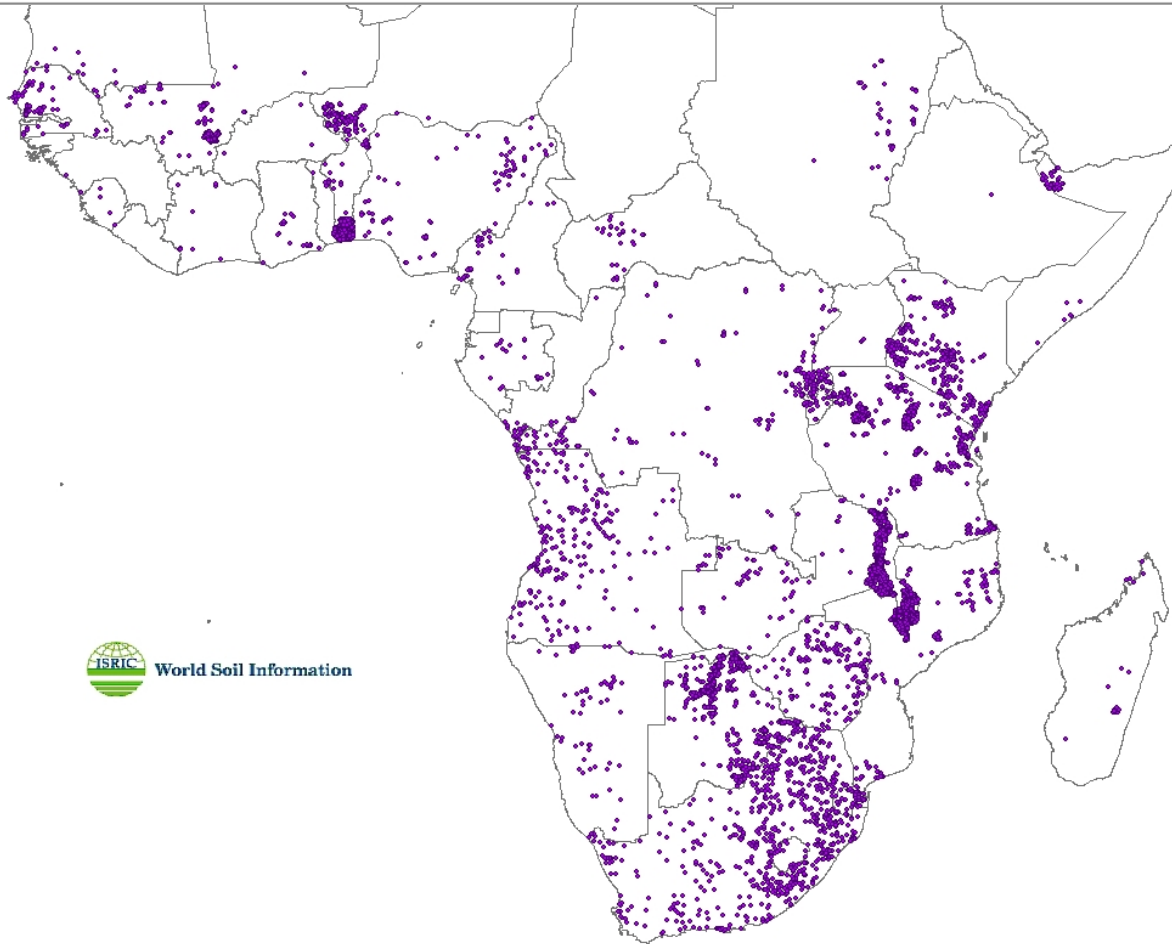
Malawi

Mali

Nigeria

Somalia

Benin



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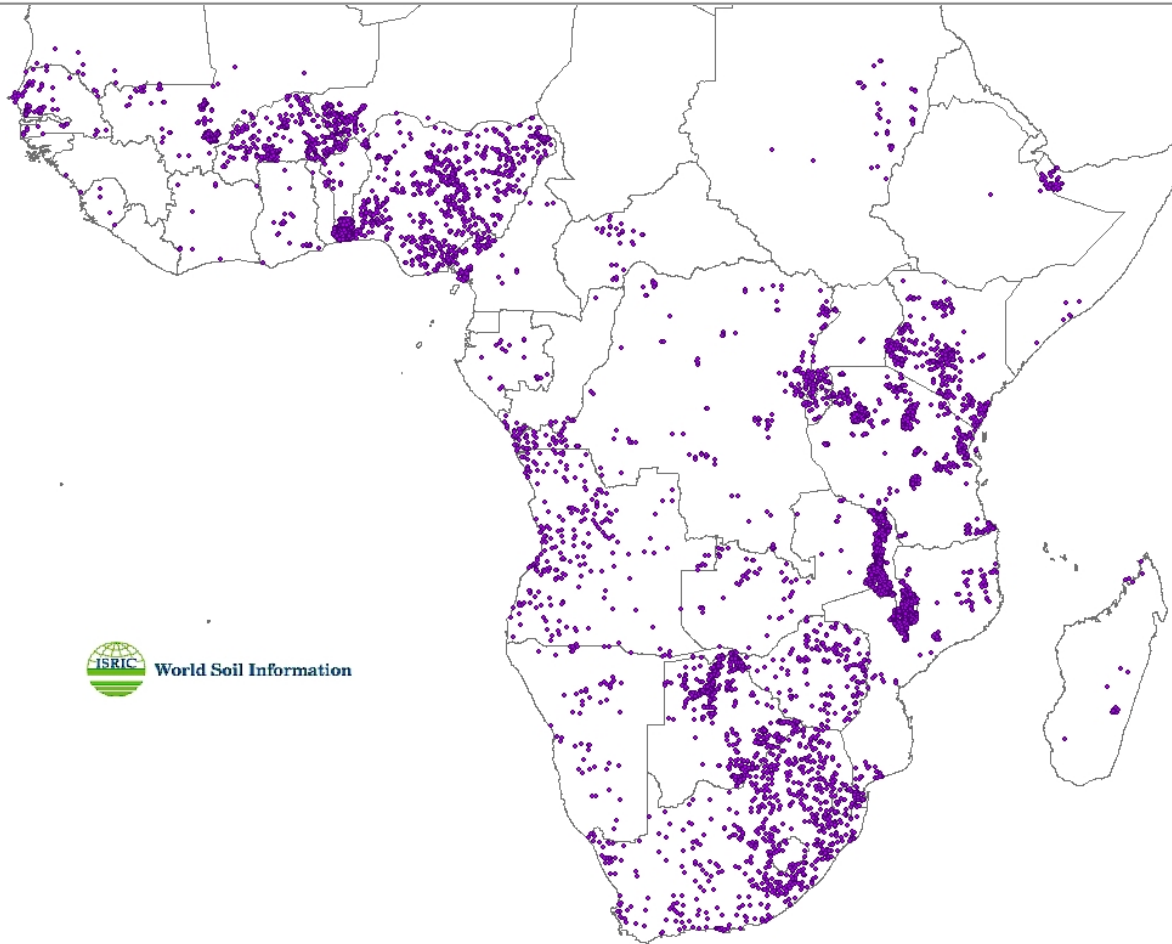
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# 2011 AfSP 2<sup>nd</sup> version : **9200** profiles

Nigeria  
Tanzania  
Kenya  
  
Congo  
Burkina



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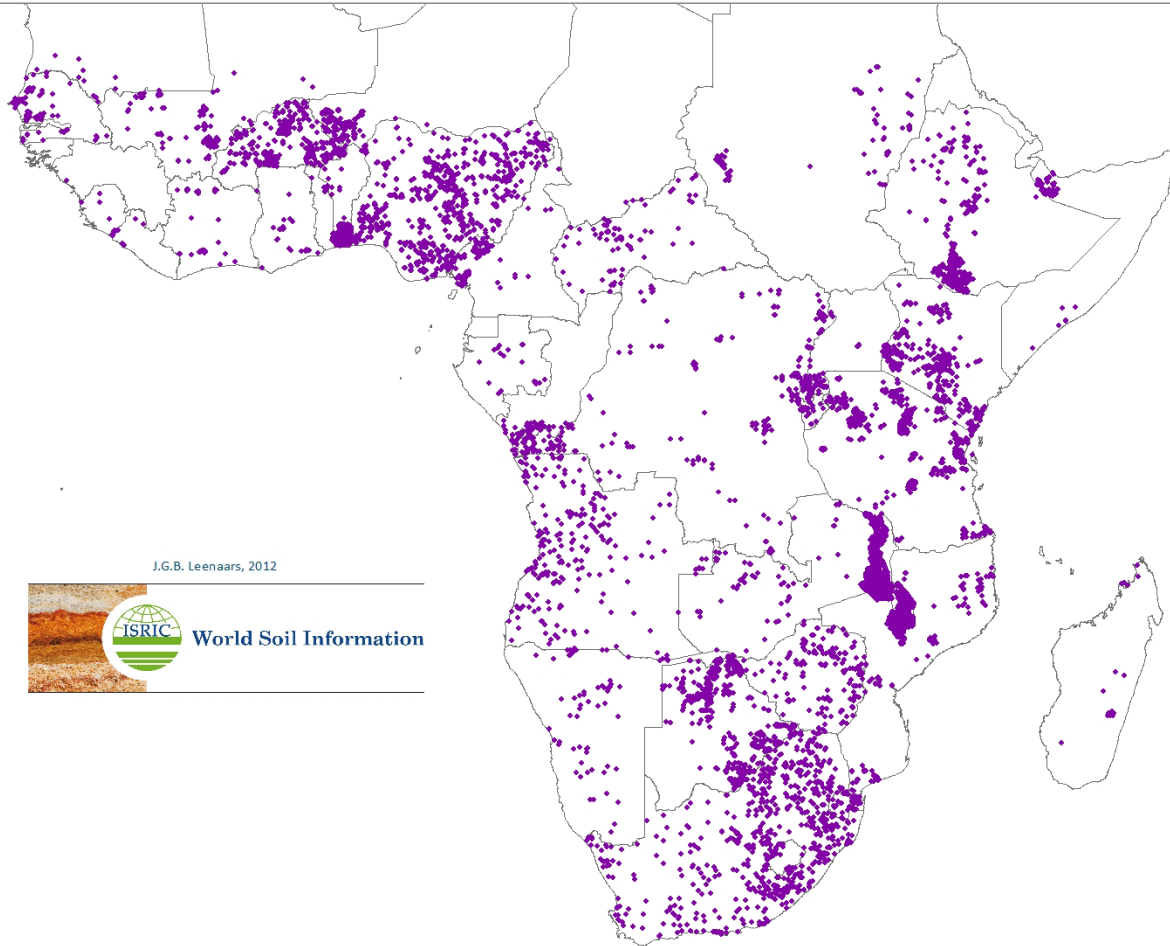
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# 2012 AfSP 3<sup>rd</sup> version : **12500** profiles

Malawi

Ethiopia

Ivory Coast



J.G.B. Leenaars, 2012



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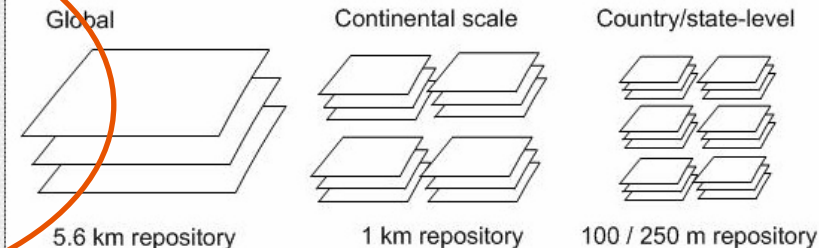


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### Open Soil Profiles

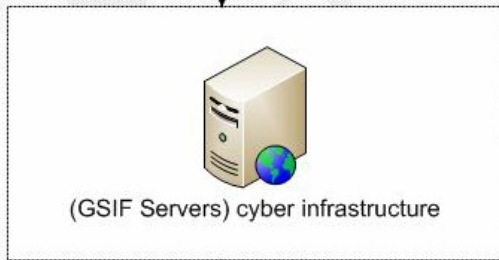
- Soil variables
- Soil site info
- Soil analytical data
- Descriptive properties

### Soil covariates (worldgrids)



### Area-class maps

- Scale:  
Global, Continental, regional
- Soil property:  
Taxonomical / analytical / site data



### GSIF Packages

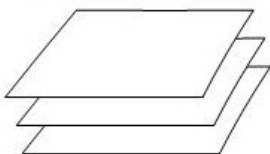
- [Map import module](#)
- [Data entry module](#)
- [Harmonization module](#)
- [Spline fitting](#)
- [Spatial analysis module](#)
- [plotKML](#)
- [Data conversion to R](#)
- [Data visualization](#)
- [Data export](#)

### Webmapping API

- [Real-time spatial prediction \(Google Maps\)](#)
- [GlobalSoilMap.net functionality for web-applications](#)
- [Geo-serving and geoprocessing functionality](#)

### Derived soil property maps

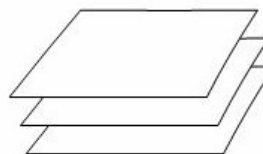
#### Global coverage



100 m (250 m, 1 km and 5.6 km)

- Six+four key soil parameters (organic carbon, pH, clay, silt, sand, coarse fragments)
- at six standard depths (0-5, 5-15, 15-30, 30-60, 60-100, 100-200 cm)
- and with included upper and lower 95% probability ranges

### Derived area-class maps



1 : 5M, 1 : 1M, 1 : 0.5M, 1 : 0.25M

- Qualitative + quantitative soil properties
- Defined depth ranges (FAO: 0-30 and 30-100; SOTWIS: 0-20, 20-40, 40-60, 60-80, 80-100)
- Documented uncertainties



# Worldgrids.org



**World Soil Information**

# Why do we need global covariates ?

---

- Objective:

Worldgrids is a (de)-central repository for collecting, storing, accessing and interacting with gridded data sets of global covariate data

- Rationale:

Worldgrid is a part of a larger GSIF. It is the physical implementation of the expectation that ISRIC would lead and coordinate a project to assemble a core data set of global environmental covariates to (partly) support local efforts to produce global soil property maps.



# Outline

---

- Examples of Datasets at ~5km
- Examples for accessing the Datasets
- Submission procedure for new and updated datasets
- Cookbook for continental/regional nodes



# Overview

- Datasets: multi thematic
- Restrictions:
  - Only about publicly available data
- Many more missing:
  - SPAM -> HarvestChoice.org
  - Admin Units -> GADM.org,
  - FEWS -> <http://earlywarning.usgs.gov>
  - OpenStreetMap

# Worldgrids – 5 km – (I)

**airports:** ([airports.zip](#)) – [World airports type \(civilian/military\)](#)  
**airroute:** ([airroute.zip](#)) – [Estimated density of airline routes](#)  
**anthroms:** ([anthroms.zip](#)) – [Anthropogenic biomes of the World](#)  
**baresoil:** ([baresoil.zip](#)) – [Bare soil area coverage based on the MERIS FR images](#)  
**biocl12:** ([biocl12.zip](#)) – [Annual Precipitation](#)  
**biocl15:** ([biocl15.zip](#)) – [Precipitation Seasonality \(Coefficient of Variation\)](#)  
**biocl1:** ([biocl1.zip](#)) – [Annual Mean Temperature](#)  
**biocl2:** ([biocl2.zip](#)) – [Mean Diurnal Range \(Mean of monthly \(max temp - min temp\)\)](#)  
**biocl4:** ([biocl4.zip](#)) – [Temperature Seasonality \(standard deviation \\*100\)](#)  
**biocl5:** ([biocl5.zip](#)) – [Max Temperature of Warmest Month](#)  
**biocl6:** ([biocl6.zip](#)) – [Min Temperature of Coldest Month](#)  
**biodvhot:** ([biodvhot.zip](#)) – [Biodiversity hotspot regions based on Conservation International](#)  
**burned:** ([burned.zip](#)) – [Burned vegetation for years 2002-2004](#)  
**cforest:** ([cforest.zip](#)) – [Closed forests coverage based on the Forest Resources Assessment \(FRA\) project](#)  
**chlom:** ([CHLOm.zip](#)) – [Mean long-term chlorophyll a concentration in the sea estimated using MODIS Aqua](#)  
**chlos:** ([CHLOs.zip](#)) – [Mean long-term chlorophyll a concentration in the sea estimated using MODIS Aqua \(standard deviation\)](#)  
**cloudfm:** ([CLOUDFm.zip](#)) – [Mean long term Cloud fraction based on MODIS monthly images](#)  
**cloudfs:** ([CLOUDFs.zip](#)) – [Standard deviation of the long term Cloud fraction based on MODIS monthly images](#)  
**countries:** ([countries.zip](#)) – [World countries based on GADM level 0](#)  
**dcoast:** ([dcoast.zip](#)) – [Distance from the sea coast line](#)  
**ecoflor:** ([ecoflor.zip](#)) – [Ecofloristic zones](#)  
**fforest:** ([fforest.zip](#)) – [Open or fragmented forests coverage based on the Forest Resources Assessment \(FRA\) project](#)  
**forestd:** ([forestd.zip](#)) – [Global Forest Density based on the Forest Resources Assessment \(FRA\) project](#)  
**fra2000:** ([FRA2000.zip](#)) – [Forest cover types based on the Forest Resources Assessment \(FRA\) project](#)



# Worldgrids – 5 km - (II)

**himpact:** ([himpact.zip](#)) — [Areas of human impacts on the Biosphere \(roads, railways and settlement density\).](#)

**hwsdmu:** ([hwsdmu.zip](#)) — [Soil mapping units and number of soil attributes based on FAO HWSD](#)

**hwsd:** ([hwsd.zip](#)) — [Soil groups based on FAO HWSD](#)

**hydrma:** ([hydrma.zip](#)) — [Mean annual concentration of hydrogen isotopes in precipitation](#)

**iflworld:** ([iflworld.zip](#)) — [The world map of intact forest landscapes](#)

**igbp\_10m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_11m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_12m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_13m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_14m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_15m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_16m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_1m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_2m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_3m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_4m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_5m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_6m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_7m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_8m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp\_9m:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)

**igbp:** ([IGBP.zip](#)) — [MOD12C1 17 land cover classes defined by the International Geosphere Biosphere Programme \(IGBP\)](#)



# Worldgrids – 5 km - (III)

**laim:** ([LAIIm.zip](#)) — [Mean long term Leaf Area Index \(downscaled\)](#)  
**lais:** ([LAIs.zip](#)) — [Mean long term Leaf Area Index \(standard deviation\)](#)  
**landcov:** ([landcov.zip](#)) — [Land cover map of the world \(1981-1995\) based on the AVHRR images](#)  
**landmask:** ([landmask.zip](#)) — [Land mask of the world based on the GSHHS data](#)  
**lisotd:** ([LISOTD.zip](#)) — [Lightning combined Flash Rate](#)  
**lstdm:** ([LSTDm.zip](#)) — [Mean Day-time MODIS Land Surface Temperature based on the monthly LST images](#)  
**lstds:** ([LSTDs.zip](#)) — [Deviation of the Day-time MODIS Land Surface Temperature based on the monthly LST images](#)  
**lstdn:** ([LSTDn.zip](#)) — [Mean Night-time MODIS Land Surface Temperature based on the monthly LST images](#)  
**lstdns:** ([LSTDns.zip](#)) — [Deviation of the Night-time MODIS Land Surface Temperature based on the monthly LST images](#)  
**mask:** ([landmask.zip](#)) — [Land mask of the world based on the GSHHS data](#)  
**modfires:** ([modfires.zip](#)) — [Year of MODIS estimated fire](#)  
**nlights:** ([nlights.zip](#)) — [World stable lights](#)  
**oxygma:** ([oxygma.zip](#)) — [Mean annual concentration of oxygen isotopes in precipitation](#)  
**pcevi1:** ([PCEVI1.zip](#)) — [EVI Principal Component #1](#)  
**pcevi2:** ([PCEVI2.zip](#)) — [EVI Principal Component #2](#)  
**pcevi3:** ([PCEVI3.zip](#)) — [EVI Principal Component #3](#)  
**pcevi4:** ([PCEVI4.zip](#)) — [EVI Principal Component #4](#)  
**pcnligh1:** ([pcnligh1.zip](#)) — [PC #1 from the World stable night lights time series](#)  
**pcnligh2:** ([pcnligh2.zip](#)) — [PC #2 from the World stable night lights time series](#)  
**pcpopd1:** ([pcpopd1.zip](#)) — [Long-term population density map \(PC1\)](#)  
**pcpopd2:** ([pcpopd2.zip](#)) — [Population change index \(PC2\)](#)  
**peatland:** ([peatland.zip](#)) — [Bog, Fen, Mire \(Peatland\)](#)  
**phh2oreg:** ([PHH2Oreg.zip](#)) — [Soil pH measured in H2O and predicted using correlation with worldmaps](#)  
**precm:** ([PRECM.zip](#)) — [Precipitation estimated based on the GSMaP](#)  
**quakein:** ([quakein.zip](#)) — [Kernel density of earthquake intensity \(magnitude\)](#)



# Worldgrids – 5 km – (IV)

**rcrops:** ([rcrops.zip](#)) — [Rainfed croplands coverage based on the MERIS FR images](#)  
**shipping:** ([shipping.zip](#)) — [Shipping density \(commercial\)](#)  
**slope:** ([slope.zip](#)) — [Slope map based on SRTM 30+ and ETOPO DEM](#)  
**snowcm:** ([SNOWCm.zip](#)) — [Mean long term snow coverage fraction based on MODIS monthly images](#)  
**snowcs:** ([SNOWCs.zip](#)) — [Standard deviation of the long term snow coverage fraction based on MODIS monthly images](#)  
**soc:** ([SOC.zip](#)) — [Soil Organic Carbon in kg/m<sup>3</sup> of soil](#)  
**soilmask:** ([soilmask.zip](#)) — [Soil areas mask](#)  
**soiltype:** ([soiltype.zip](#)) — [KST Global Soil Regions](#)  
**sstm:** ([SSTm.zip](#)) — [Mean long-term sea surface temperature estimated using MODIS Aqua](#)  
**ssts:** ([SSTs.zip](#)) — [Mean long-term sea surface temperature estimated using MODIS Aqua \(standard deviation\)](#)  
**stormtr:** ([stormtr.zip](#)) — [Density of Tropical Cyclone Storm Tracks \(historical\)](#)  
**swamp:** ([swamp.zip](#)) — [Swamp Forest, Flooded Forest](#)  
**treecov:** ([treecov.zip](#)) — [Continuous Fields Tree Cover for 1992-1993](#)  
**wildness:** ([wildness.zip](#)) — [World wilderness areas](#)  
**wooded:** ([wooded.zip](#)) — [Other wooded land coverage based on the Forest Resources Assessment \(FRA\) project](#)  
**wwfeco:** ([wwfeco.zip](#)) — [Terrestrial ecoregions](#)  
**gaccessm:** ([gaccessm.zip](#)) — [Estimated travel time to major cities \(>50k\) in hours](#)  
**gcarb:** ([gcarb.zip](#)) — [Global Biomass Carbon Map](#)  
**glc2000:** ([glc2000.zip](#)) — [Land Cover classes for year 2000 based on the SPOT VEGA2000 dataset](#)  
**glcrop:** ([glcrop.zip](#)) — [Cropland areas in 1992](#)  
**globcov:** ([globcov.zip](#)) — [Land Cover classes based on the MERIS FR images](#)  
**globedem:** ([globedem.zip](#)) — [Global Relief Model based on SRTM 30+ and ETOPO DEM](#)  
**glwd31:** ([glwd31.zip](#)) — [Global Lakes and Wetlands](#)  
**gmia:** ([gmia.zip](#)) — [Global map of area equipped for irrigation expressed as percentage of total area](#)  
**gshpub:** ([GSH PUB.zip](#)) — [GSHAP Global Seismic Hazard Map](#)



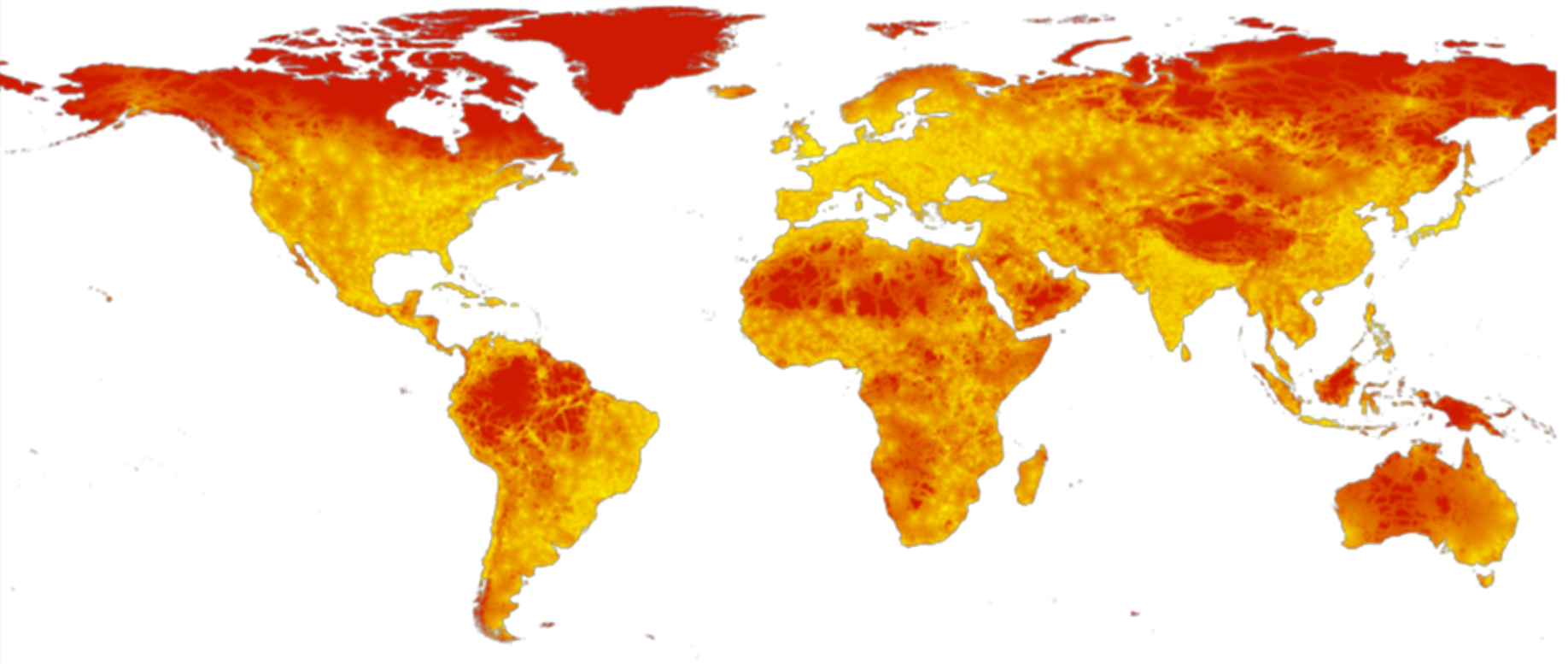
# “Human Influence” Datasets



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# Global Accessibility Map

Estimated travel time to major cities (>50k) in hours



Slide Credit: Reuter/Hengl, 2001



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<http://bioval.jrc.ec.europa.eu/products/gam/>

Nelson, A., 2008. Travel time to the nearest city of 50,000 or more people in year 2000. Global Environment Monitoring Unit - Joint Research Centre of the European Commission, Ispra, Italy.

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# World stable lights – 2009



Slide Credit: Reuter/Hengl, 2001

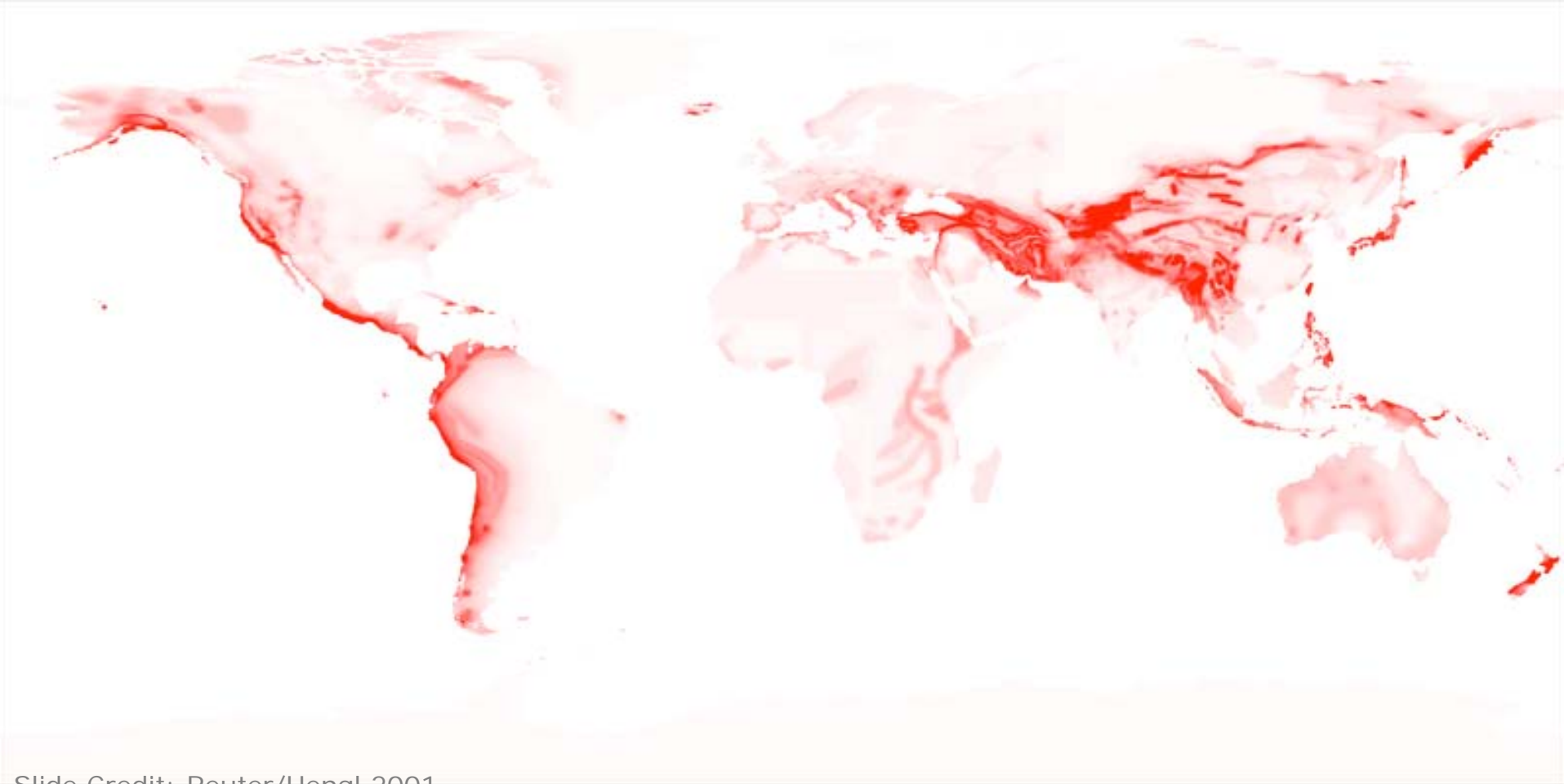


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<http://ngdc.noaa.gov/dmsp>  
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# Global Hazard Map

GLOBAL SEISMIC HAZARD ASSESSMENT PROGRAM



Slide Credit: Reuter/Hengl, 2001



World Soil Information

<http://www.seismo.ethz.ch/gshap/>

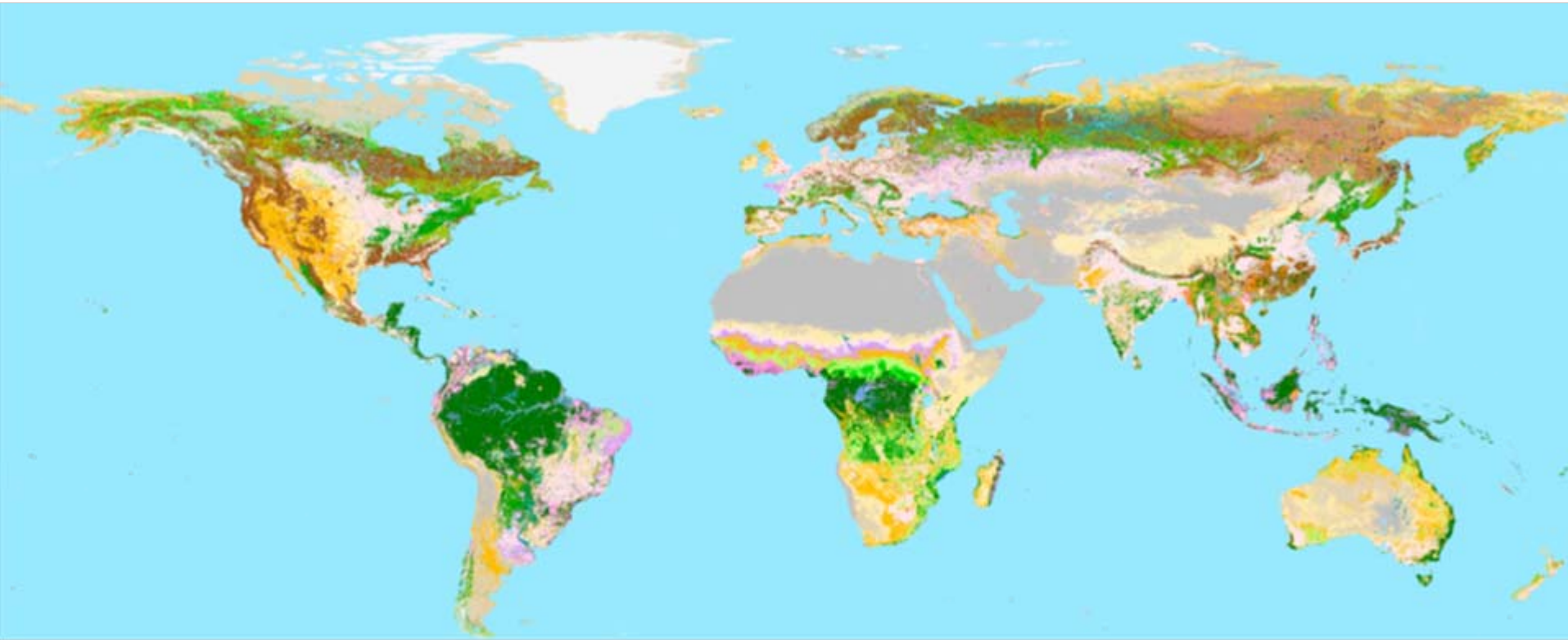
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# Landuse



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# Global Land Cover 2000 (GLC)



Land Cover classes for year 2000 based on the SPOT VEGA2000 dataset

Slide Credit: Reuter/Hengl, 2001

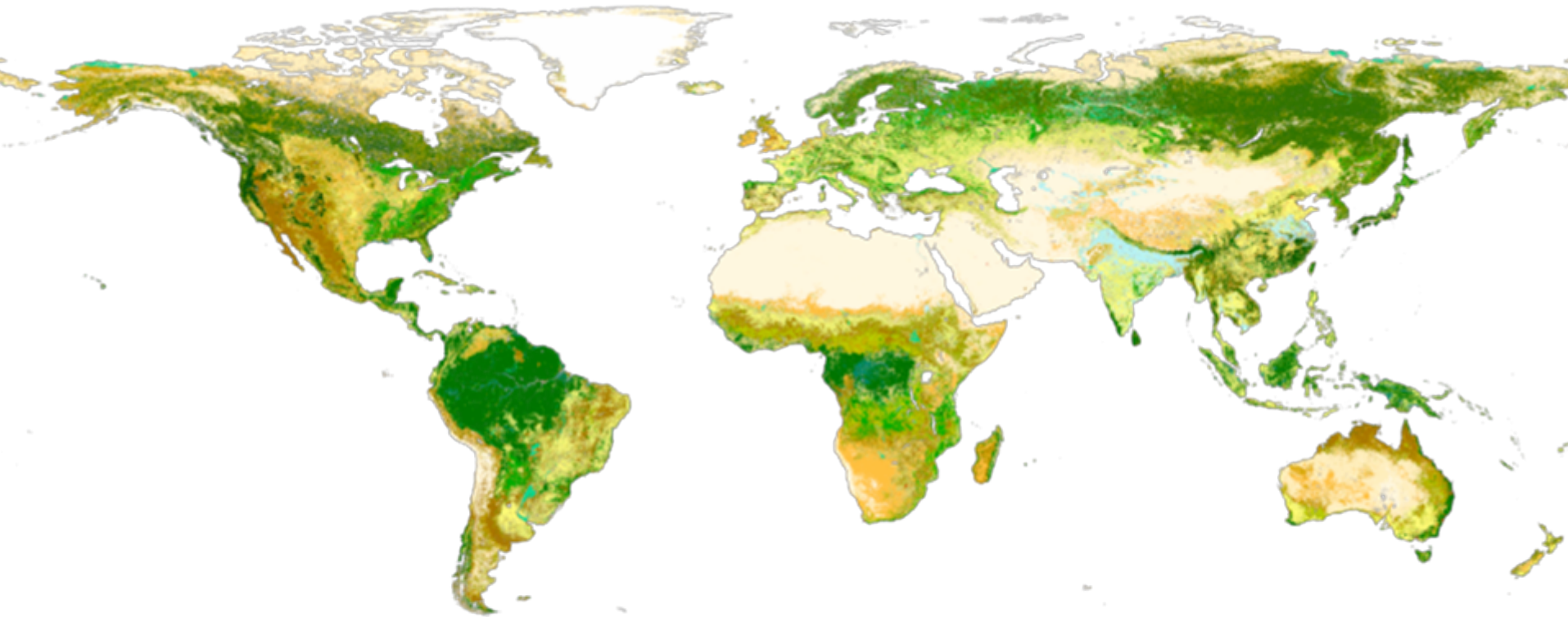


World Soil Information

<http://bioval.jrc.ec.europa.eu/products/glc2000/glc2000.php>

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# Globcover



Land Cover classes based on the MERIS FR images 2000-2005

Slide Credit: Reuter/Hengl, 2001



World Soil Information

<http://ionia1.esrin.esa.int>

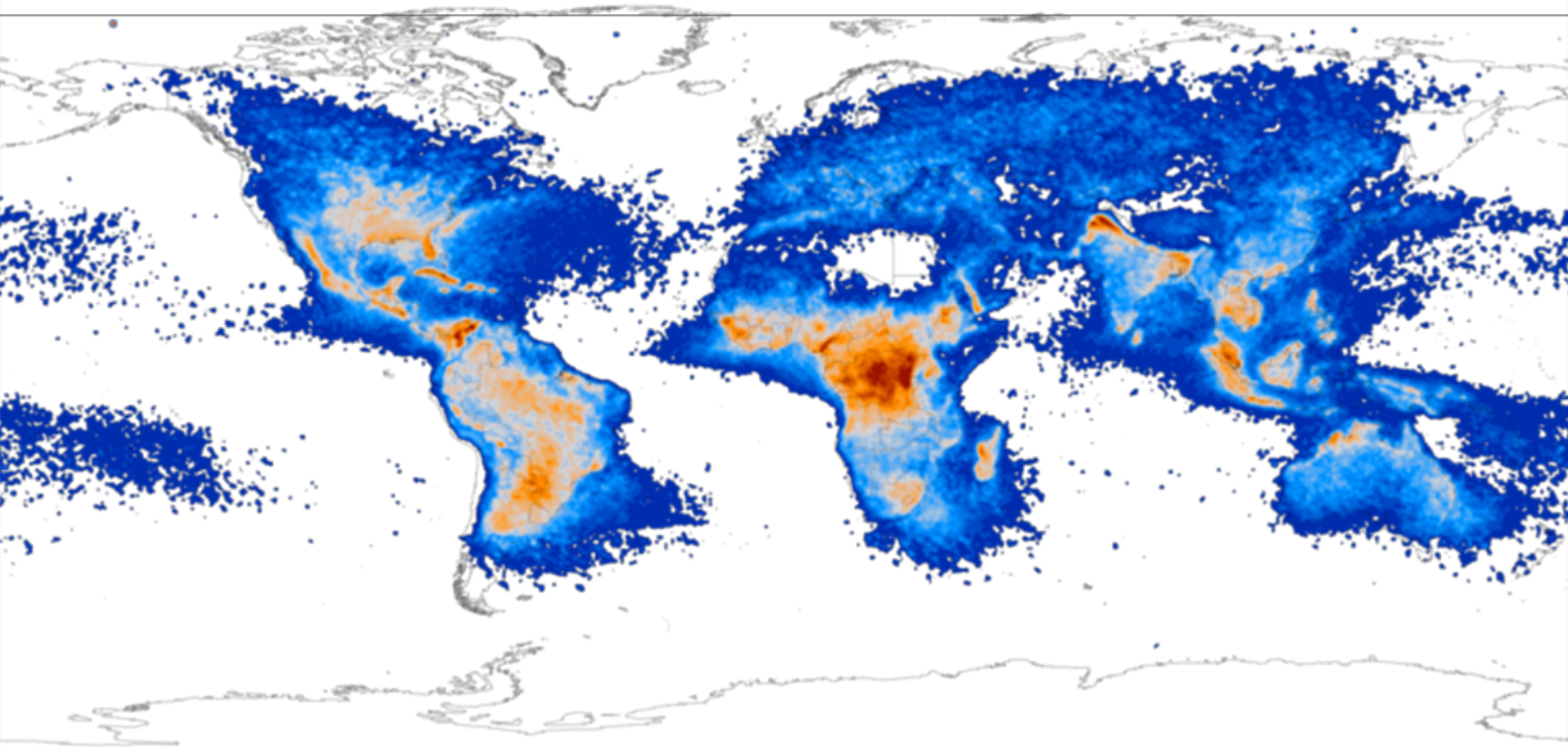
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# Climate



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# Lightning Map 1998-2005



Slide Credit: Reuter/Hengl, 2001

<http://thunder.msfc.nasa.gov>

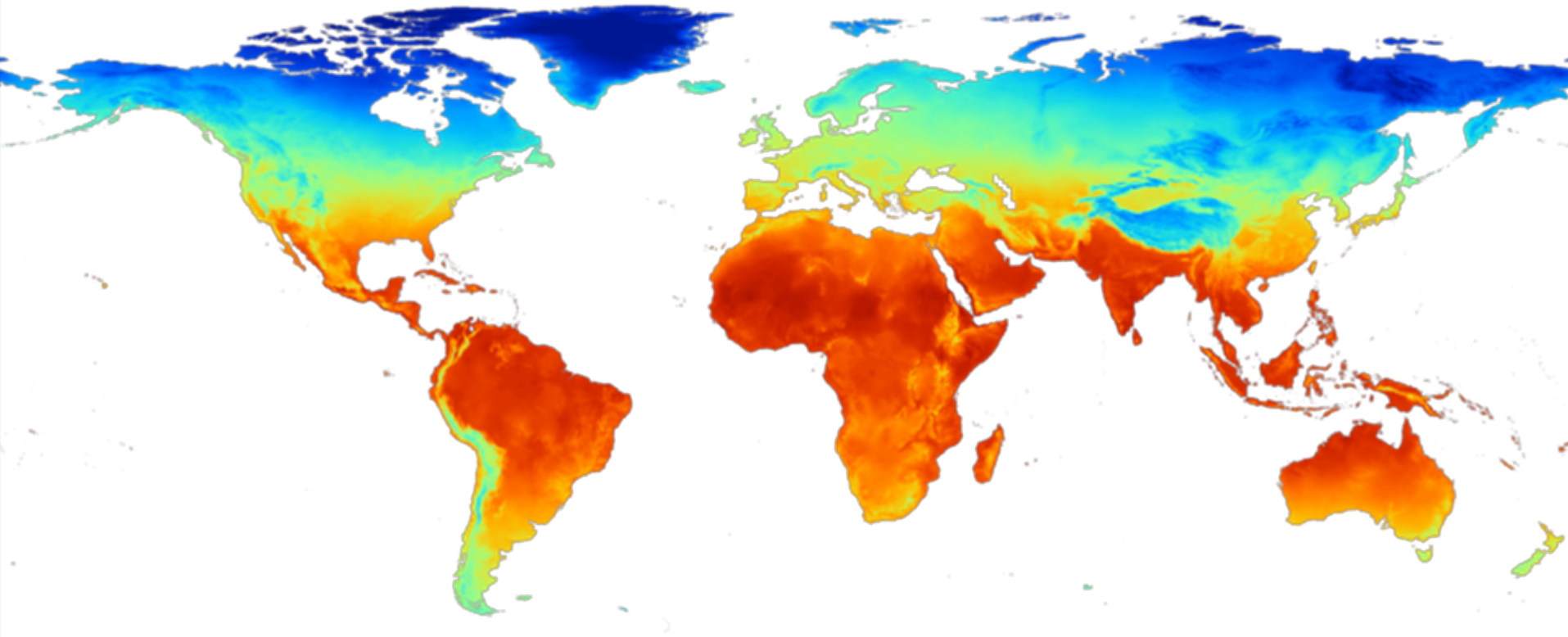
Christian, HJ et al 2003. Global frequency and distribution of lightning as observed by the Optical Transient Detector. *J. Geophys. Res.*, 108 4005.

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World Soil Information

# BIOCLIM1 Annual Mean Temperature



Slide Credit: Reuter/Hengl, 2001

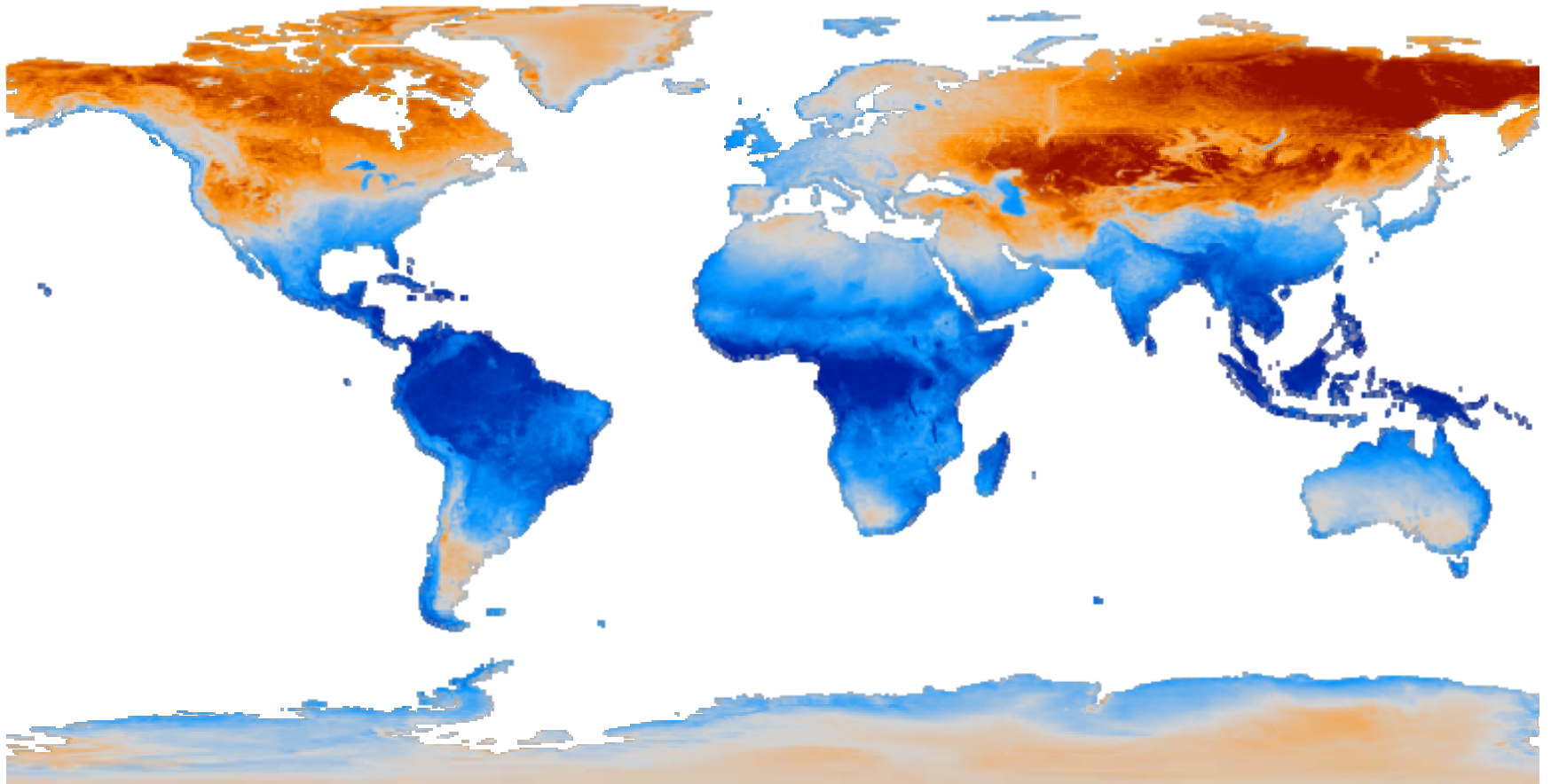


World Soil Information

<http://www.worldclim.org>

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# Deviation of the Day-time MODIS Land Surface Temperature based on the monthly LST images



Slide Credit: Reuter/Hengl, 2001

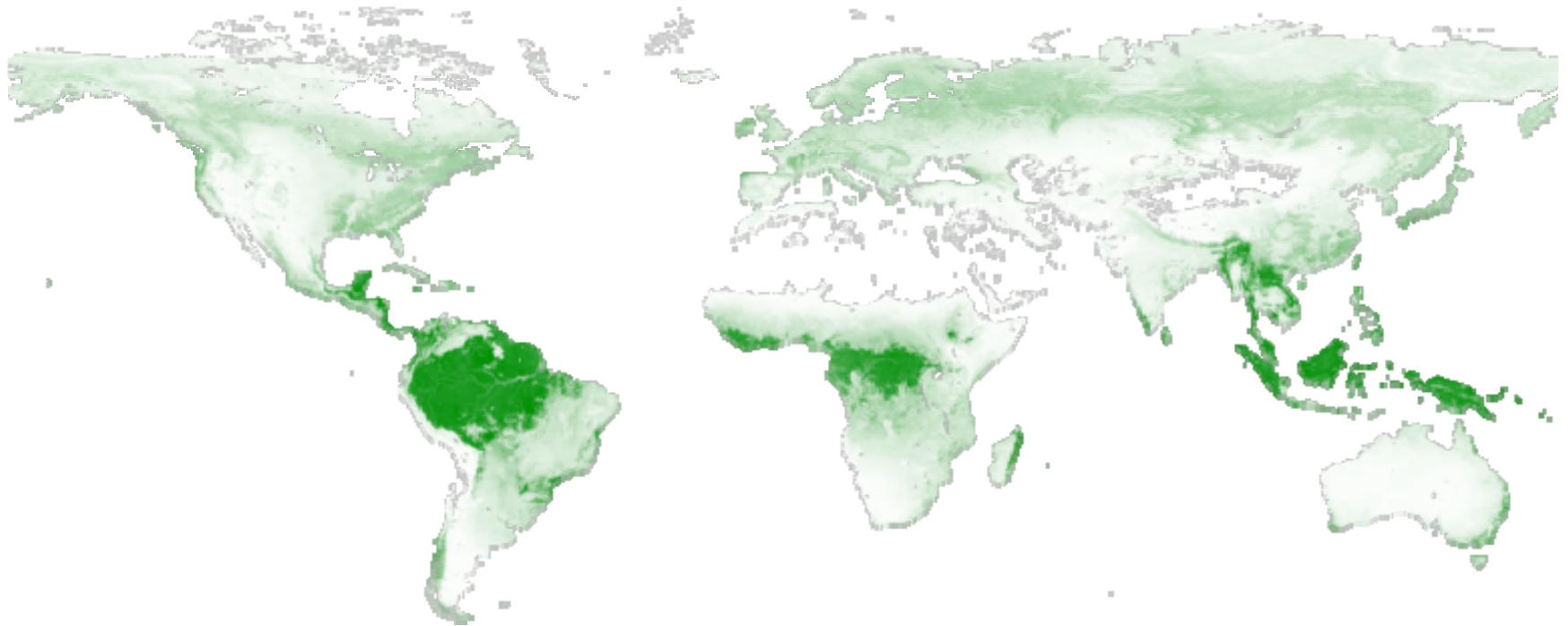


World Soil Information

<http://lpdaac.usgs.gov>

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# Mean long term Leaf Area Index (downscaled) 2000-2010



Slide Credit: Reuter/Hengl, 2001



World Soil Information

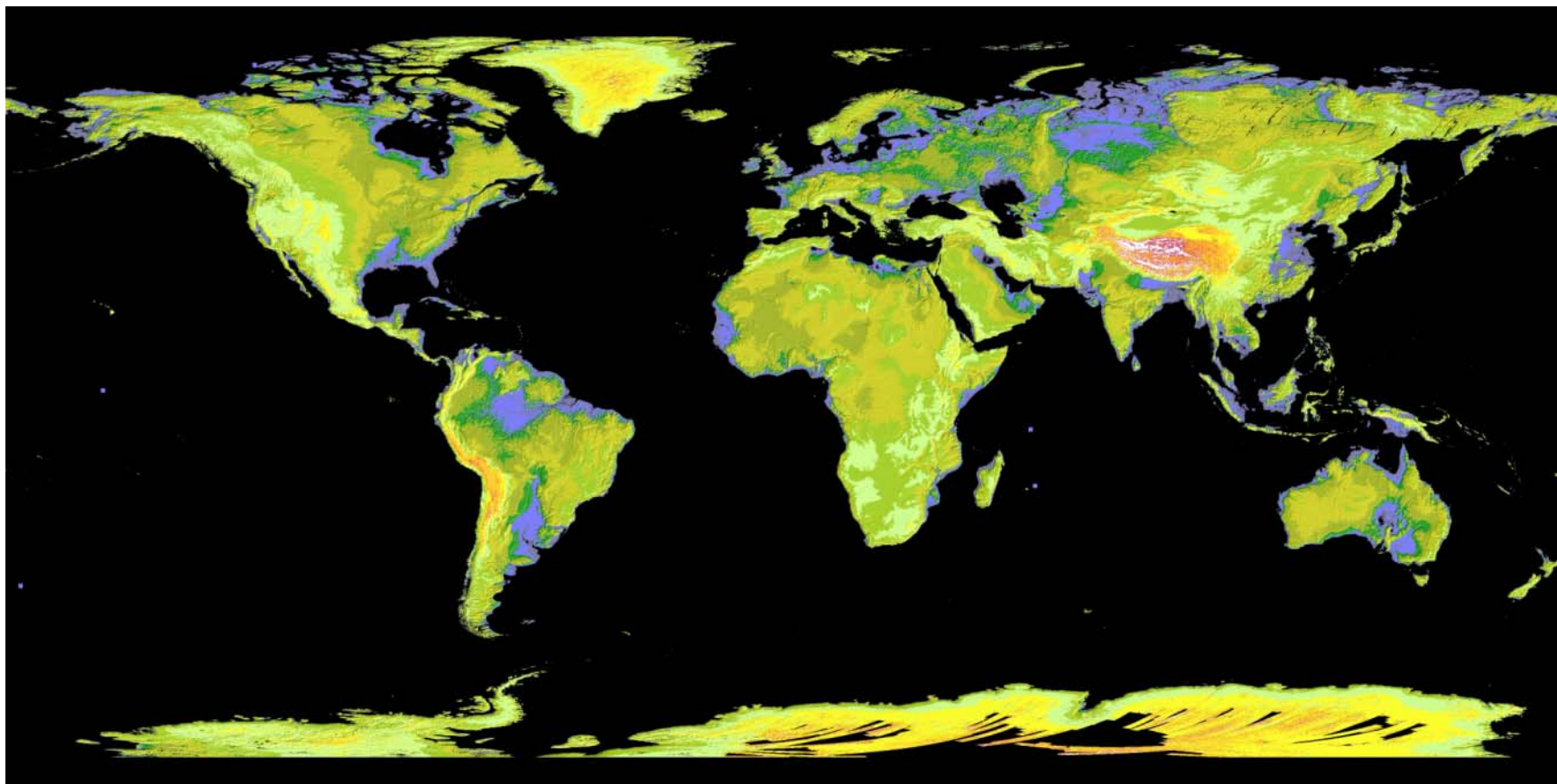
<http://neo.sci.gsfc.nasa.gov>

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# Global DEM datasources



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# Functions which we need

---

- overlay 1 point to extract covariate data
- overlay n points to extract covariate data
- Subset a specific extent to to extract covariate data
- Aggregate to specific area



# Functionality

- querying for a single value from a defined covariate map (*sample*)
  - [http://wps.worldgrids.org/pywps.cgi?service=wps&version=1.0.0&request=execute&identifier=sample\\_r\\_local1pt\\_nogml&datainputs=\[x=11.3;y=12.1;inRastername=biocl15\]](http://wps.worldgrids.org/pywps.cgi?service=wps&version=1.0.0&request=execute&identifier=sample_r_local1pt_nogml&datainputs=[x=11.3;y=12.1;inRastername=biocl15])
- querying for mass values from a defined covariate map
- extraction of a defined subset from a defined covariate map (*subset*)
  - [http://wps.worldgrids.org/pywps.cgi?service=wps&version=1.0.0&request=execute&identifier=subset&datainputs=\[bbox=25,25,40,40;inRastername=biocl15\]&responsedocument=OutData=@asreference=true](http://wps.worldgrids.org/pywps.cgi?service=wps&version=1.0.0&request=execute&identifier=subset&datainputs=[bbox=25,25,40,40;inRastername=biocl15]&responsedocument=OutData=@asreference=true)
- creating of an overlay of a user specified zone grid and a defined covariate map (*zonalstats*).
  - [http://wps.worldgrids.org/pywps.cgi?service=wps&version=1.0.0&request=execute&identifier=overlay&datainputs=\[inRastername=globedem;inZone=http://ftp.isric.org/short/ztest.tif;stype=sd\]&responsedocument=OutData=@asreference=true](http://wps.worldgrids.org/pywps.cgi?service=wps&version=1.0.0&request=execute&identifier=overlay&datainputs=[inRastername=globedem;inZone=http://ftp.isric.org/short/ztest.tif;stype=sd]&responsedocument=OutData=@asreference=true)



# How to access it ?

---

Examples:

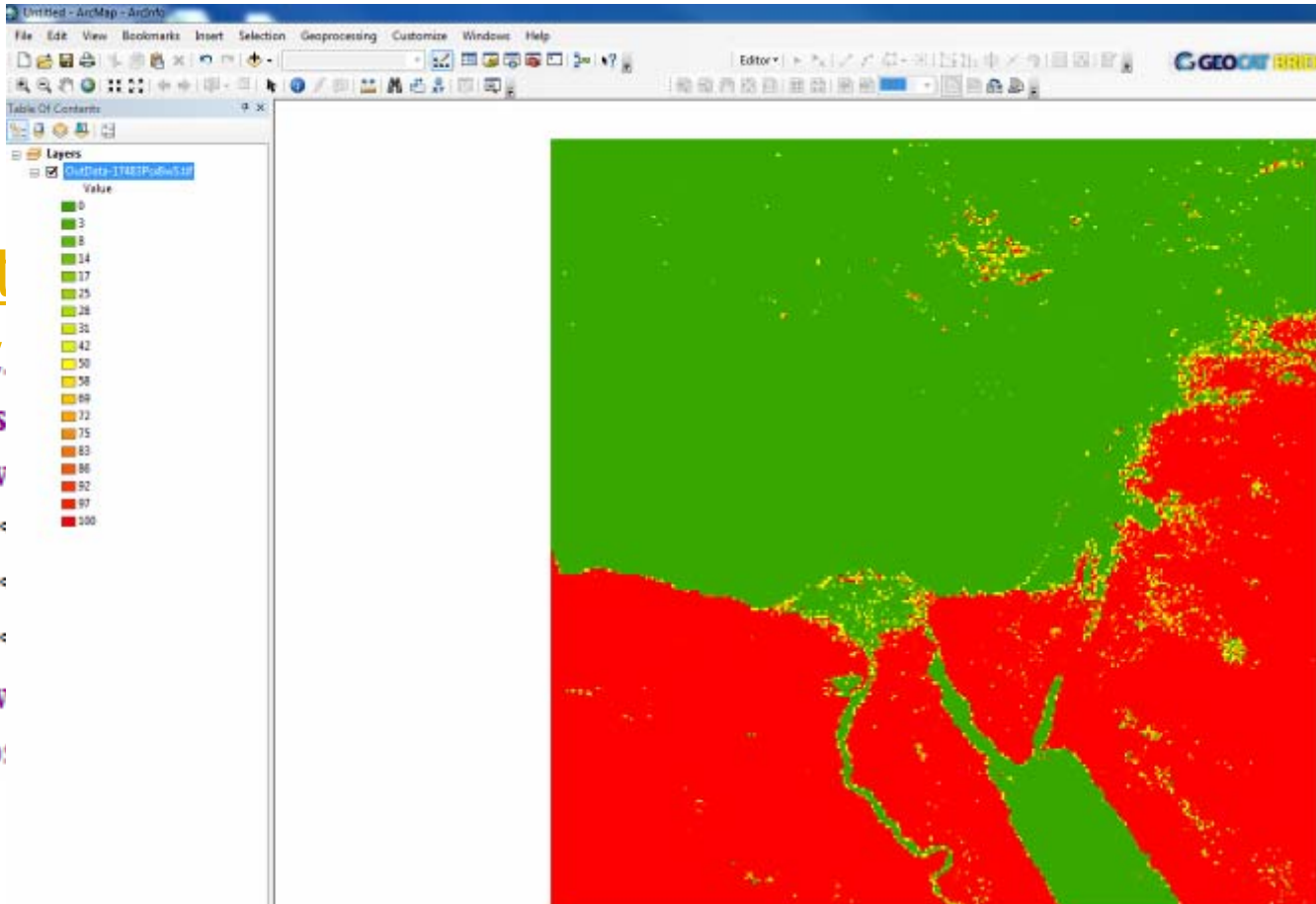
WWW – Browser

ArcGIS or R-project



# Process: Get subset from a specific grid

- `<u>ht</u>`
- `<wps>`
- `<w>`
- `<v>`
- `</wps>`



345ZpY1qi.tif' mim

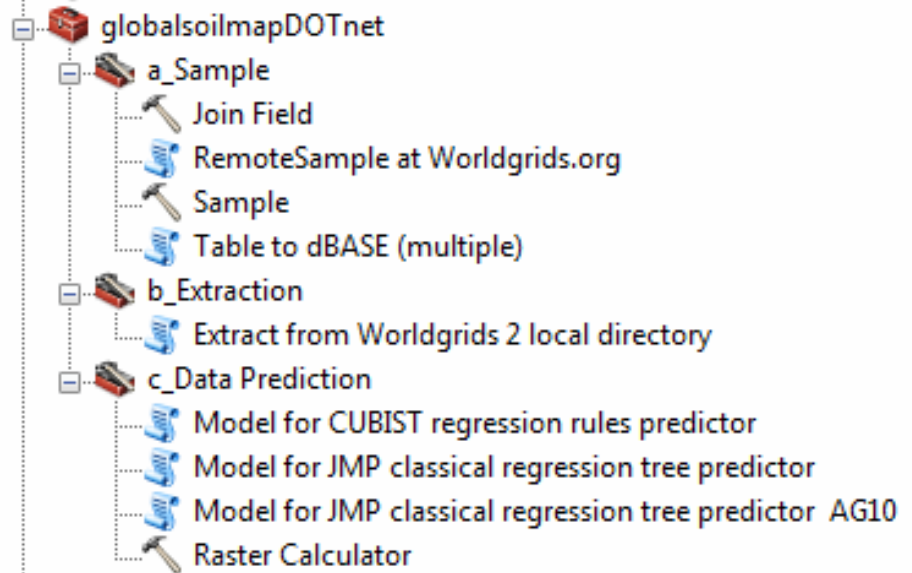
ce=  
ntifie



# R-function in GSIF R library

## ArcGIS GSIF Toolbox (e.g. for globalsoilmap.net)

```
#### subset worldgrids.org:
GNsubworldgrids <- function(wps.server, layername, bbox) {
# bbox = bounding box as matrix(c(LatMin, LatMax, LonMin, LonMax), nrow=2)
require(RCurl)
if(missing(wps.server)){ wps.server <- "81.169.165.102/pywps" }
if(nrow(bbox)==2&ncol(bbox)==2&bbox[1,1]>-180&bbox[1,2]<180&bbox[2,1]>-90&bbox[2,2]<90){
tmp <- getURL(paste('http://', wps.server, '/pywps.c
objectname <- strsplit(strsplit(tmp, '<wps:Reference
if(length(objectname)>0){
download.file(objectname, destfile=set.file.extensio
else { stop("Layer not available. Visit www.worldgr
}
else stop("Bounding box required as matrix with LatM
GDALinfo(set.file.extension(paste(layername, paste(a
})
```



# Outline

---

- Examples of Datasets at ~1km and ~5km resolution
- Examples for Accessing the Datasets using OGC - WPS services
- Submission procedure for new and updated datasets
- Cookbook for continental/regional nodes



# Submission procedure for Global Datasets

- Worldgrids focus is on global datasets !
- Nodes may implement their own repositories for continental/regional focus!
- Submit Email with data details, metadata records to [worldgrids@globalsoilmap.net](mailto:worldgrids@globalsoilmap.net)
- Preferred Data transfer(FTP) at submitter or load to ISRICs FTP service
- Preferred data format (GeoTIFF) on the same raster as the ~1km or ~5km datasets
- MetaData Description needs to accompany the dataset, otherwise no publication ! Sorry.
- ISRIC will perform QA\QC and maintain the directory.



# Cookbook for local server installation

## Scripts for data preparation

Article Discussion

### Cookbook for pyWPS installation

#### Install

(assuming we have a debian 6 OS, this is written not for a no apt-get update ( to have the latest versions from the server)

apt-get install python-gdal-bin python-gdal python-scipy aparc

apt-get install python-htmltmpl python-xml python-magic (So mkdir /opt/install (ok, create a directory)

cd /opt/install (change into that directory)

wget https://svn.osgeo.org/osgeo/livedd/gisvm/trunk/bin/install\_pywps.sh

chmod 700 install\_pywps.sh (change permission, by the svn checkout https://svn.wald.intevation.org/svn/pywps/trunk)

cd trunk

python setup.py install --dry-run (install the wps without actual installation)

python setup.py install (install wps )

If R functionality in python is needed install rpy2 etc

apt-get install libgdal-dev r-base-dev

apt-get install python-rpy2

```
getHRFCdata.R
# title      : getHRFCdata.R
# purpose    : download and resampling of lightning maps ();
# reference  : [http://spatial-analyst.net/wiki/index.php?title=Global_datasets]
# producer   : Prepared by T. Hengl
# last update : In Amsterdam, NL, April 2010.
# inputs     : images available at [ftp://e4ftl01u.ecs.nasa.gov];
# outputs    : geotiff images projected in the "+proj=longlat +ellps=WGS84" system;
# remarks 1  : Description of the data set available at [ftp://ghrc.nsstc.nasa.gov/pub/data/lis/climatology/H
# remarks 2  : First download and install FWtools [http://fwtools.maptools.org];

# -----
# Initial settings and data download:
# -----

library(rgdal)
workd <- paste(gsub("/", "\\\\", getwd()), "\\", sep="")

download.file("ftp://ghrc.nsstc.nasa.gov/pub/data/lis/climatology/HRFC/LISOTD_HRFC_V2.2.hdf", destfile=paste(getwd(), "HRFC_V2.2.hdf", sep=""))

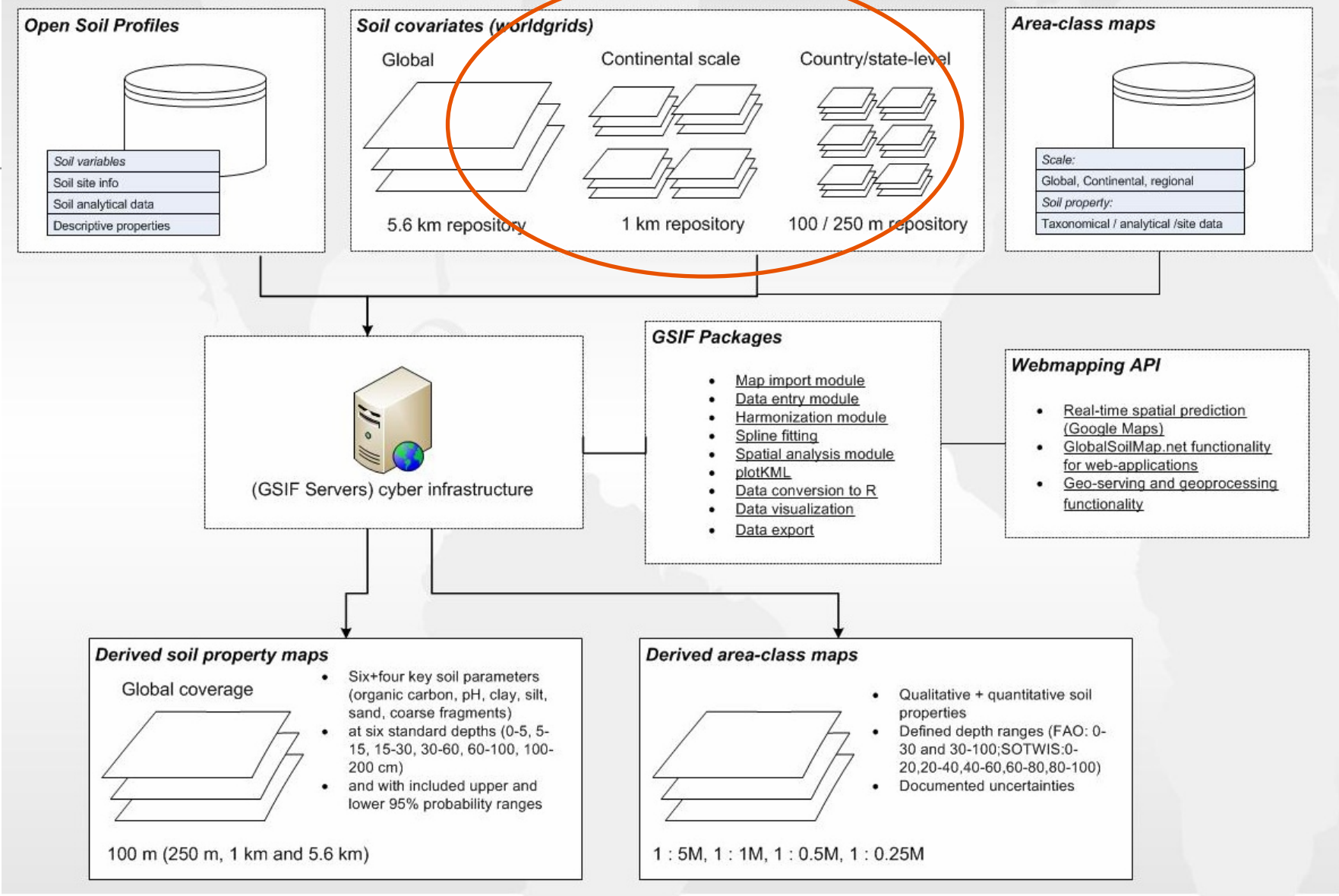
# extract the layer of interest:
system(paste("C:\\PROGRA-1\\FWTOOL-1.7\\bin\\gdal_translate.exe HDF4_SDS:UNKNOWN:\\", workd, "\\LISOTD_HRFC_V2.2", "LISOTD.hdf", "LISOTD.sdaf", sep=" "))

# flip the map and add coordinates:
rsaga.geoprocessor(lib="grid_tools", module=19, param=list(INPUT="LISOTD.sgrd", RESULT="LISOTDf.sdaf", METHOD=1))
LISOTD <- readGDAL("LISOTDf.sdaf")
LISOTD$v <- round(LISOTD$band1, 1)
# str(LISOTD)
# fix the georeference:
LISOTD@bbox <- matrix(c(-180,-90,180,90), ncol=2, dimnames=list(c("x", "y"), c("min", "max")))
LISOTD@grid@cellsize <- c(0.5, 0.5)
LISOTD@grid@cellcentre.offset[1] <- -179.5
LISOTD@grid@cellcentre.offset[2] <- -89.5
proj4string(LISOTD) <- CRS("+proj=longlat +datum=WGS84")
writeGDAL(LISOTD["v"], "LISOTDc.sdaf", "SAGA", mvFlag=-1)

# downscale to 5 km resolution:
system("C:\\PROGRA-1\\FWTOOL-1.7\\bin\\gdalwarp.exe LISOTDc.sdaf -t_srs \"+proj=longlat +ellps=WGS84\" LISOTD.tif")

# end of script;
```





# GSIF Packages

- prediction and visualisation -



**World Soil Information**

# Example – Nigeria – ArcGIS Toolbox using Cubist

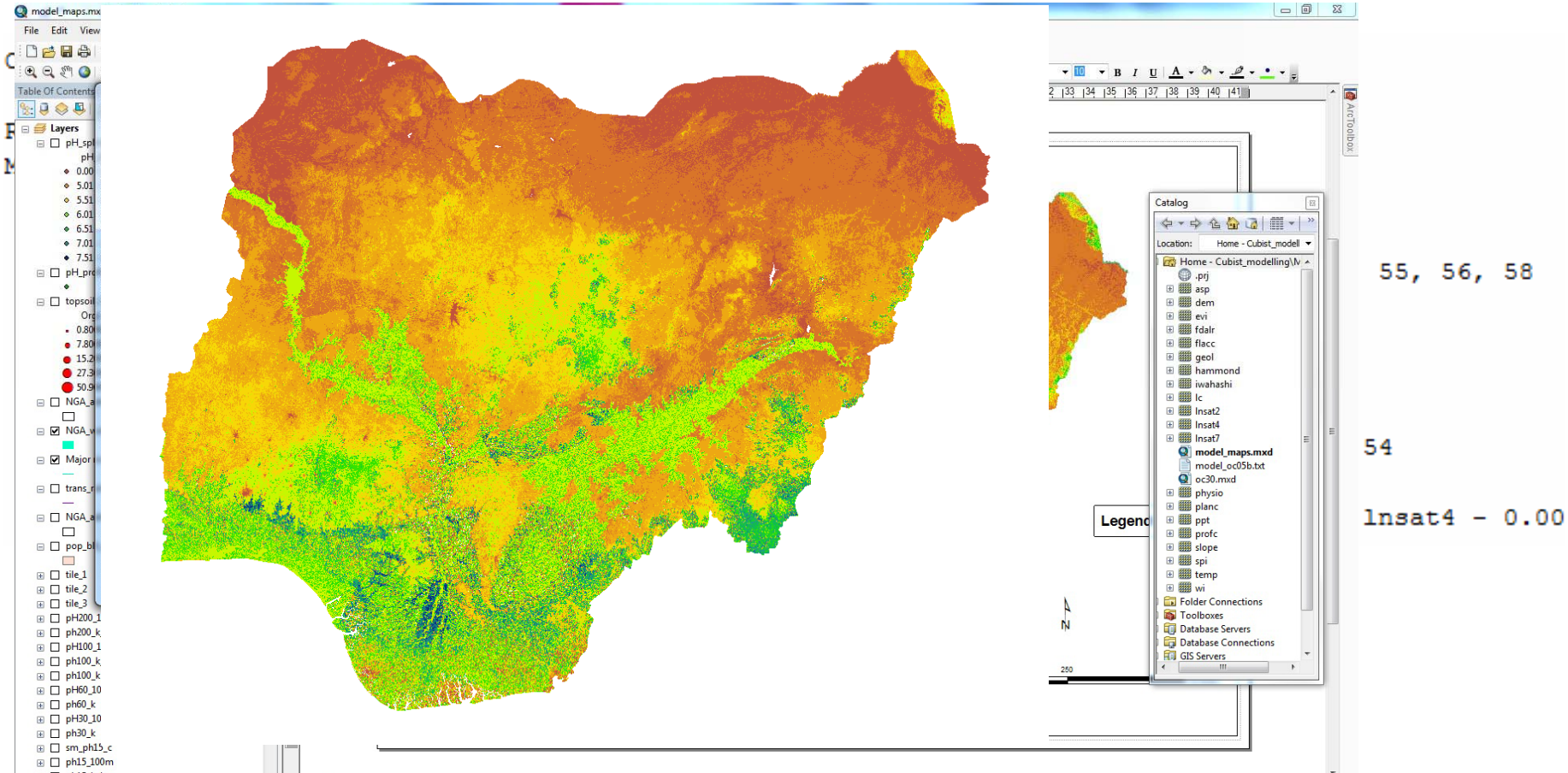


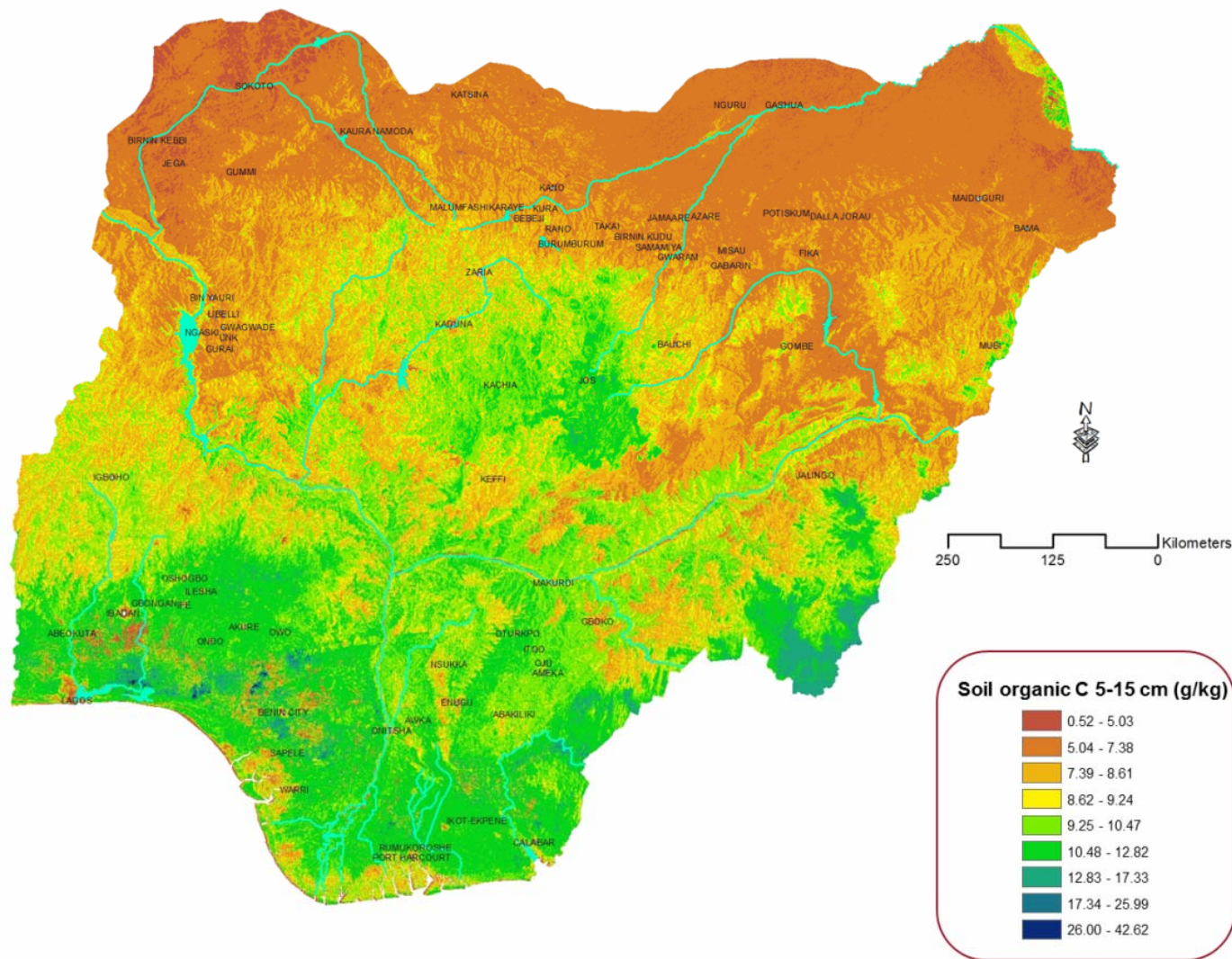
**World Soil Information**

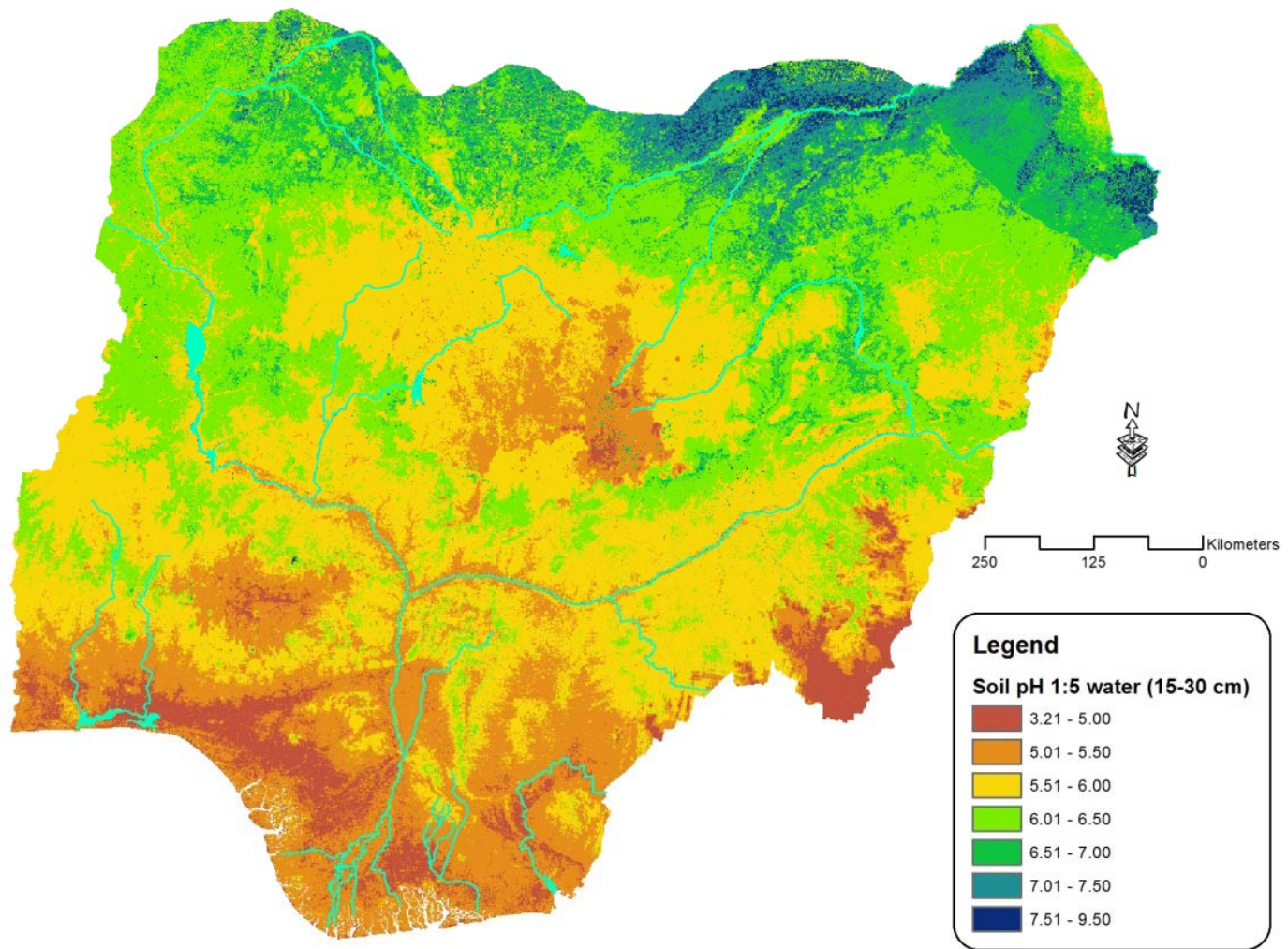
[http://www.globalsoilmap.net/content/globalsoilm  
apnet-prediction-toolbox](http://www.globalsoilmap.net/content/globalsoilm<br/>apnet-prediction-toolbox)

# Rationale for WPS -

any arbitrary soil map production process - which uses auxiliary information







World Soil Information

[www.globalsoilmap.net](http://www.globalsoilmap.net)

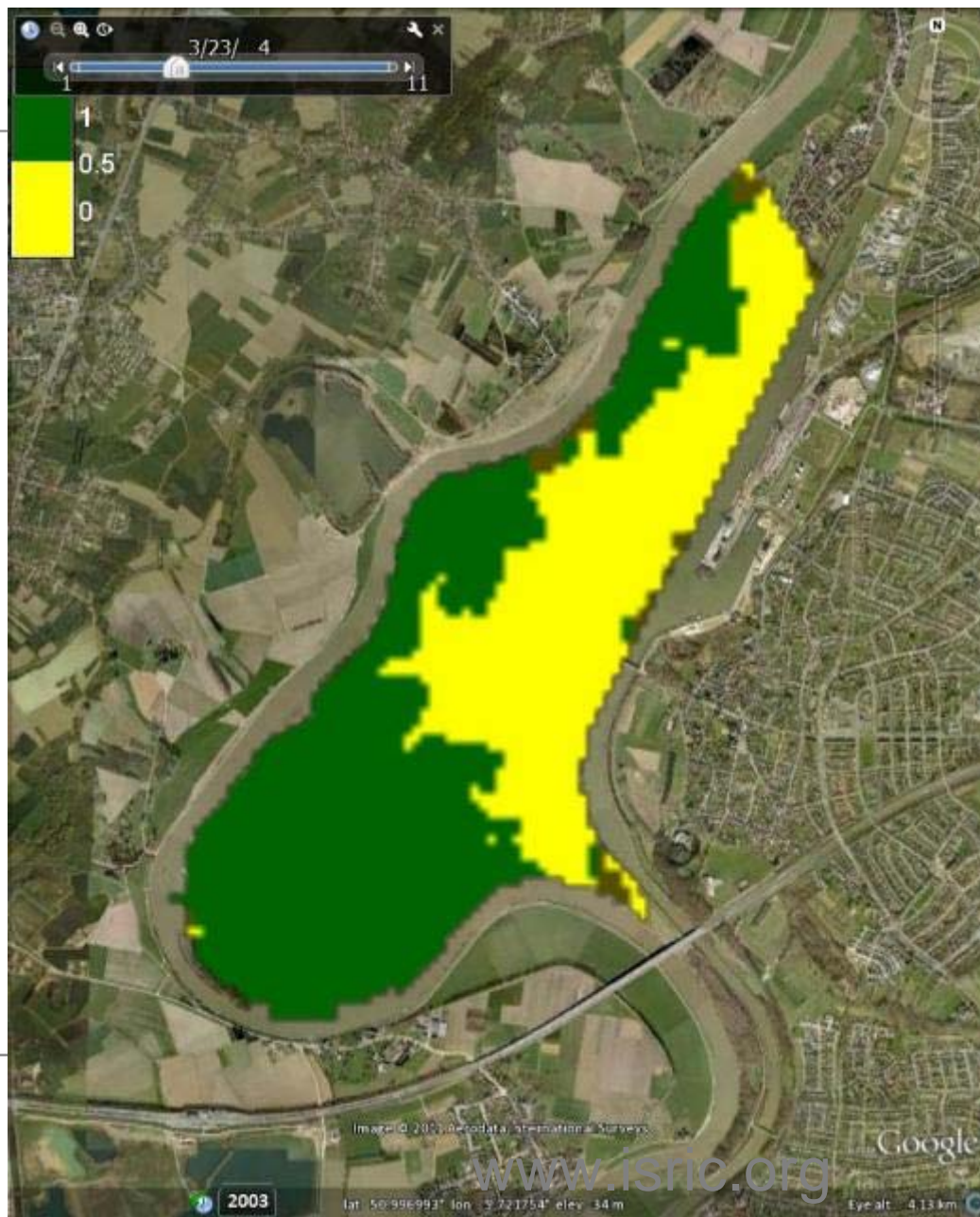
Advancing the Science and Technology of Soil Information in Asia

# Example – Meuse/Malawi – R Toolbox



**World Soil Information**

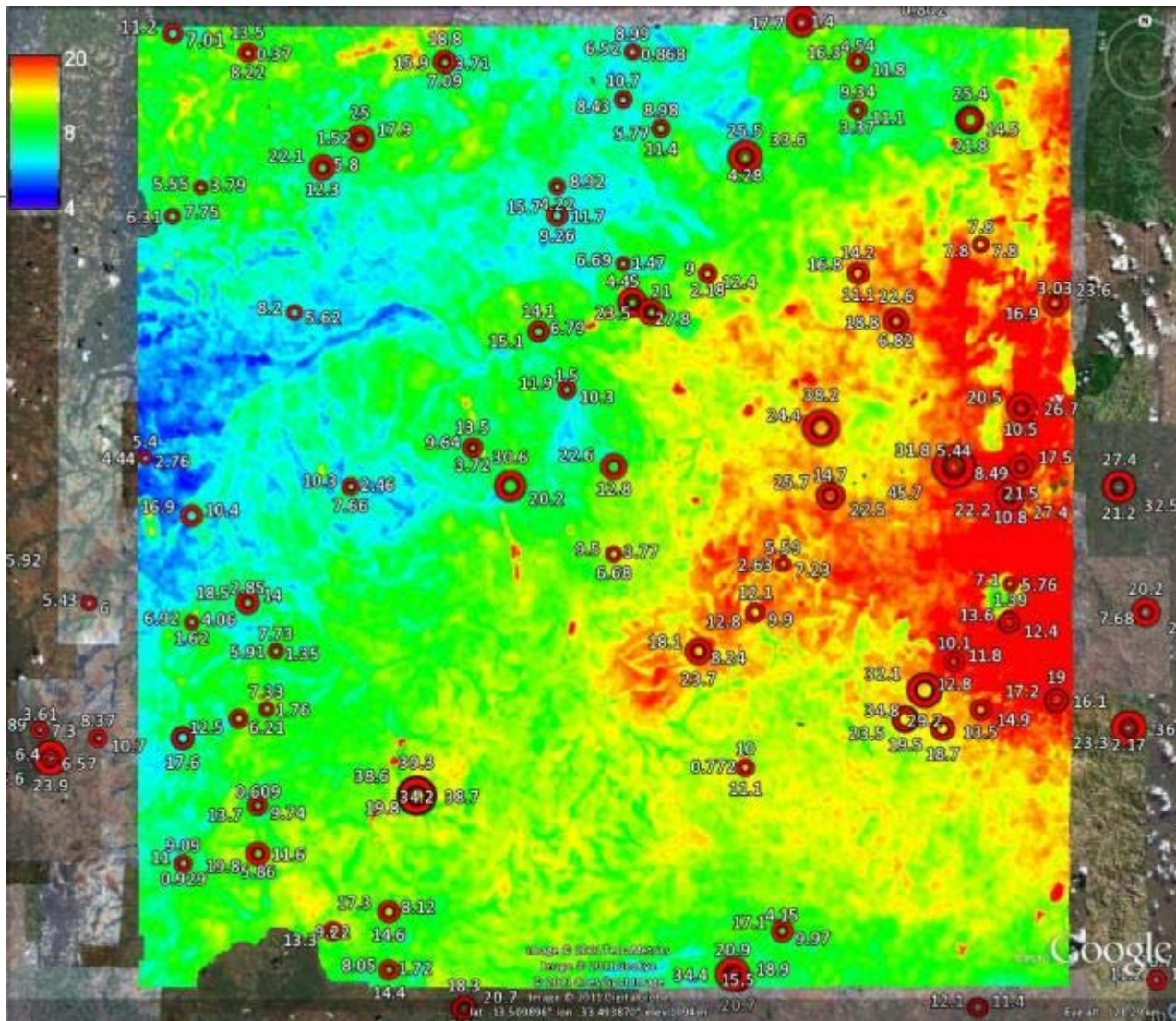
# Animated display of uncertainty in mapping soil classes



soiltype\_sims\_anigif.kml



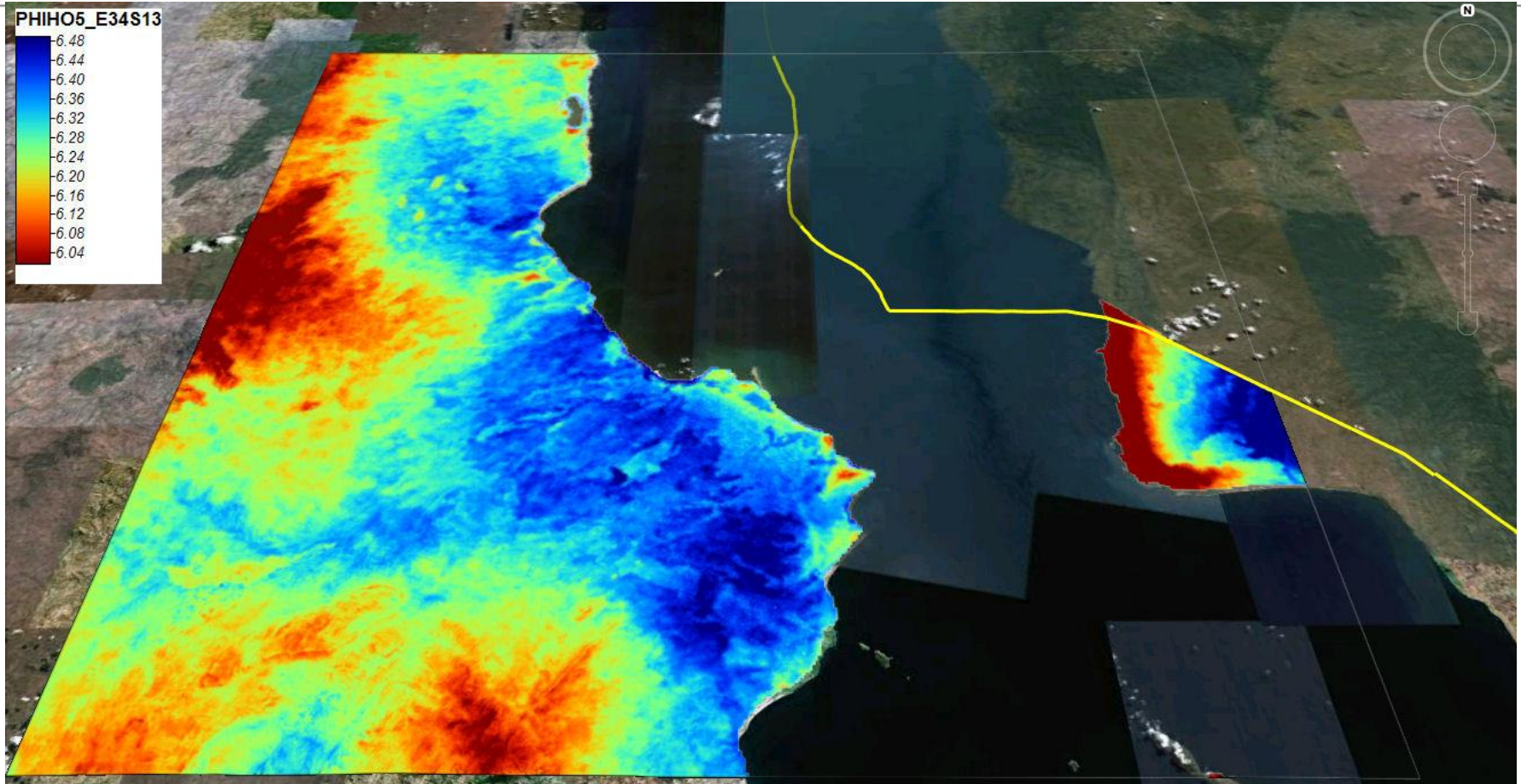
World Soil Information



Predictions of soil organic carbon for first standard depth (2.5 cm) for block E33\_S14



# Soil Legacy Data for Africa



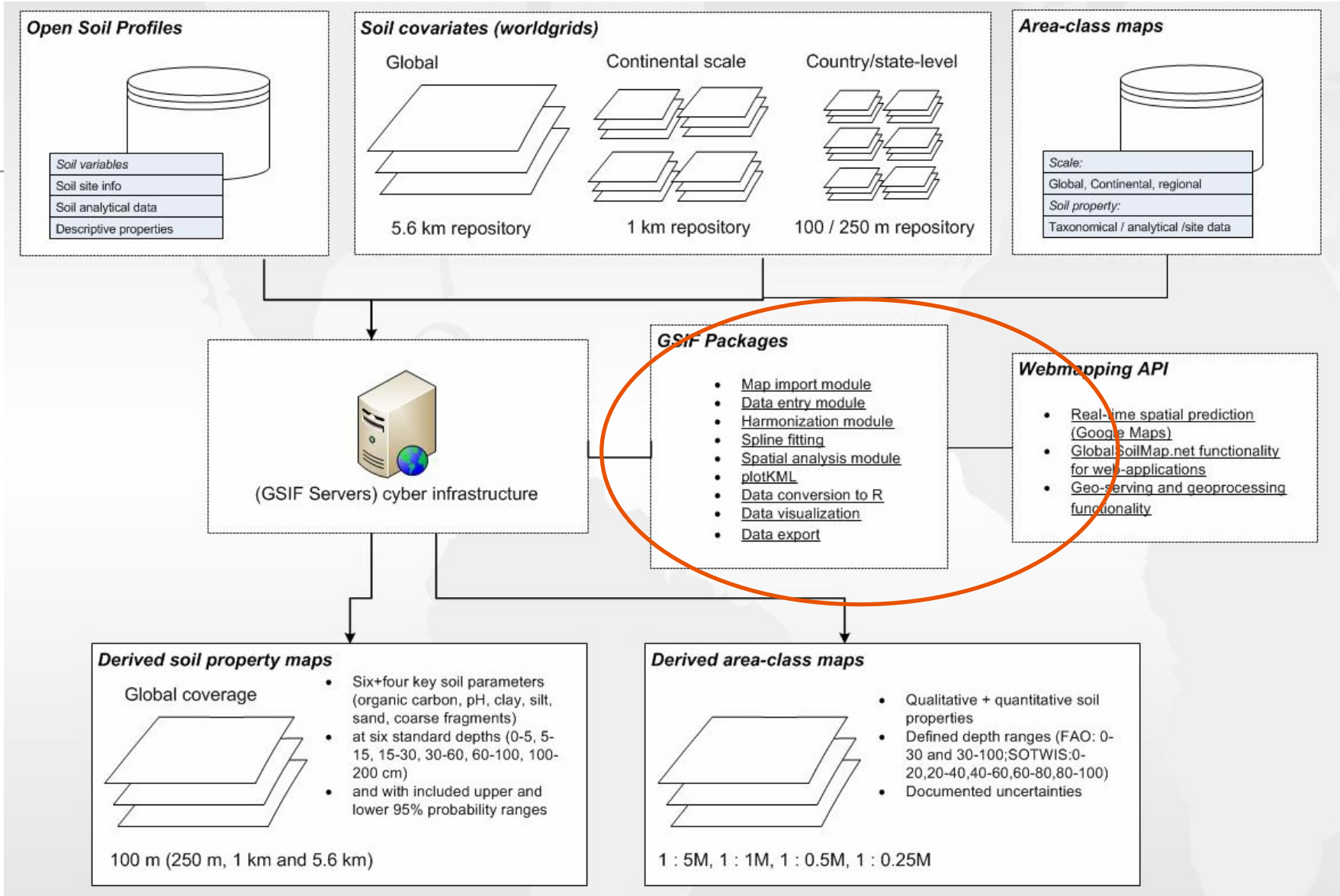
Slide credit: Tom Hengl, 2011



World Soil Information

ISRIC is developing multi-scale methods for harmonizing soil property maps

Advancing the Science and Technology of Soil Information in Asia



# Conclusions

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- GSIF is a framework for enhancing, collating, harmonizing, and use of soil and covariate data to assist production of global soil information at various resolutions
- using collaborative cooperation which brings in the required soil knowledge from local participants
- Components:
  - Soil Property Maps, OpenSoilProfile, Worldgrids.org
  - GSIF Packages, GSIF Manual



# Think globally – Act locally

We can do this – through collaboration and sharing of information



**World Soil Information**